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Road Surface Reflectance Measurements in Ontario

F. W. Jung
Senior Research Officer

A. I. Titishov
Research Engineer

A. Kazakov
Research Officer

Research and Development Branch, MTC

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Authors (name, title and/or organisation):
F.W.Jung, Senior Research Officer, R&D Branch, MTC
A.I.Titishov & A.Kazakov, Research Officers, R&D Branch, MTC

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Abstract:

This report is part of an effort to collect and document data related to pavement surface properties of Ontario highways, for the general purpose of studying their correlation with pavement type, mix design, and with wear or consolidation under traffic. In particular, this report deals with the light reflectance of pavement surfaces, knowledge of which is needed for illumination design.

This report documents the first extensive measurement and classification study of Ontario pavements, and presents the latest instrumentation and procedure for such measurements. Information is presented which is based on North American experience and materials, demonstrating the variation in the reflectivity parameter values in terms of instrument related and pavement-texture related fluctuations.

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1/ INTRODUCTION

This report is part of an effort to collect and document data related to pavement surface properties of Ontario highways, for the general purpose of studying their correlation with pavement type, mix design, and with wear or consolidation under traffic.

In particular, this report deals with the light reflectance of pavement surfaces, knowledge of which is needed for illumination design.

As early as 1979 the Ministry (MTC Ontario) and Transport Canada have entered an agreement to develop instrumentation and measure pavement reflectance in conjunction with skid resistance measurements. So far, no significant correlation was found between skid measurements and light reflectance, and the skid measurements are relegated to a separate report which also contains the parallel measurement results on tire noise.

Attempts to develop measuring equipment to be used directly on the road surfaces proved futile because of insurmountable technical difficulties. However, development of laboratory instrumentation and measurement procedures finally succeeded using economically small sample sizes of 150 to 200 mm diameter.

In the mid-sixties an innovative method for the design of highway lighting was introduced and implemented in Europe. This method utilizes the luminance, i.e., the amount of reflected light measured from the roadway surface, as a design standard. Previous design methods were based on the illuminance or incident light which, although it illuminates the roadway surface, is not seen directly by the observer or the driver. The observer perceives only that portion of the incident light which is reflected from the roadway surface in his direction. It is therefore reasonable to use reflected light or "luminance" as the basis of standards for the design of roadway lighting.

The main difficulty associated with the luminance method has been the acquisition and classification of reflectance properties of road surfaces. Thus major research was directed towards this task [References 1 to 7], especially during the mid-sixties and mid-seventies. Finally, in

1981, the American Illumination Engineering Society (IES) adopted the luminance method for illumination design of expressways and freeways, and has also initiated the development of even more advanced methods based on luminance contrast and "visibility index". Such development is feasible with modern instrumentation and computers. Based on concepts which were first developed in Europe, the Ministry of Transportation and Communications of Ontario (MTC) developed a computer program for fixed highway lighting [8], which was presented to IES in 1975. The feasibility of the luminance methods based on European classifications of road surfaces [4] was demonstrated in this way.

The acceptance of the luminance method (or of more advanced methods) on this continent has created a need for proper equipment to measure reflectance matrices of pavement surfaces. The attempt to develop a field instrument, a "black box" device for such measurements on the road was not successful, because of technical difficulties, but the development of a laboratory method of measurement was finally accomplished by MTC and the University of Toronto [9]. To this date, similar attempts to develop instrumentation for road reflectance measurements in the U.S. have not succeeded.

The Ontario Road Reflectance Matrix Photometer developed at the University of Toronto is based on the CIE (Committee International de l'Eclairage) recommendations [4], except for the use of smaller (6" or 150 mm) pavement samples which are easily shipped and handled. These samples are extracted with a normal cylindrical core drill and at least three samples from the same pavement must be taken and measured for statistically significant results. (More details of the statistical studies on sample dimensions and numbers of cores are presented in Chapter 5 and in the Appendix A.) Measurements are partly automated, thereby contributing to the economy of the procedure. At this time the instrument is capable of measuring dry samples only, but future modifications for measuring wet samples [3] have been considered and are feasible.

This report is to document the first extensive measurement and classification study of Ontario pavements, and to present the latest instrumentation and procedure for such measurements.

For the first time, information is presented which is based on North American experience and materials, demonstrating the variation in the reflectivity parameter values in terms of instrument related and pavement-texture related fluctuations, (i.e., pavement composition and aggregate type, size and positioning of the viewing area, consistency in mixing procedure and quality control, and the influence of wear, polishing, compaction and contamination caused by traffic volumes).

In conclusion, it must be pointed out that this project has been sponsored jointly by the Ontario Ministry of Transportation and Communications and by Transport Canada in Ottawa.

2/ REFLECTANCE MATRIX

The basic principle of road surface reflectance measurement in the laboratory is illustrated in Figure 1. The sample is placed horizontally on a rotating table, centred at P, and is illuminated from various positions determined by the angle γ. A photometer M, measures the reflected light or luminance with a constant angle of inclination set at $\alpha = 1°$. The table with the rigidly fixed photometer and the sample rotates around the axis A-A', so that the vertical projections of the light beam axis S-P and the viewing axis M-P on the plane of the sample form successive increments of a rotating angle β varying from zero to 180°. The luminous intensity I, of the lamp S, pointing toward P is kept constant by tight voltage control.

The corresponding road geometry is shown in Figure 2. In the CIE system and the system described in this paper, the influence of the angle δ is neglected ($\delta = 0$), and the angle α is fixed at one degree. The laboratory measurements are automatically processed, and a matrix of reduced luminance coefficients, $R(\beta, \tan\gamma)$, is calculated and printed. Each coefficient R, is calculated by the following relationship:

$$R = L\ H^2/I$$

where: L = luminance measured at P, in cd/m^2
H = height of lamp above the sample surface, in metres ($\cong 0.68$ m)
I = luminous intensity of the lamp, in lumen

Note that the coefficient R is reduced by a factor $\cos^3\gamma$ applied to the normal luminance coefficient q, ranging from zero to $1/\pi$ for a perfect white diffusor. Table 1 presents an example of a matrix printout with R-values multiplied by 100 000. The table also shows the CIE reflectance parameters Q0, S1, and S2 for this particular matrix. The "modified values" are calculated from improved values of R(0, 0) and R(0, 2) based on averages or non-linear regression analysis. In accordance with Reference 4, the parameters are defined as follows:

S1 = R(0, 2)/R(0, 0)
S2 = Q0/R(0, 0)

where: R(0,2) = reduced luminance coefficent for B = 0 and tan $\gamma = 2$
R(0,0) = reduced luminance coefficent for B = 0 and tan $\gamma = 0$
Q0 = average luminance coefficient as defined in Reference 2.

All normal measurements of the matrix values R were carried out on samples of 150 mm (6") diameter, on a centrally located field-of-view of 65 mm by 115 mm.

The detailed procedure of sampling is described in Appendix B, and the details of experimental techniques are given in Reference 3.

3/ THE CIE CLASSIFICATION CRITERIA

Comprehensive work has been done on the classification of reflectance matrices [2, 3, and 7], all in terms of the parameters Q0, S1, and S2. The average luminance coefficent, Q0, which expresses the general brightness of the surface, depends on the colour and degree of polish of the aggregates and the amount of asphalt on the surface. The other two parameters, S1 and S2, express the degree of specularity which a texture exhibits and they depend on the grittiness or smoothness of the surface texture, i.e., the degree of polish of the aggregate and its prevailing angularity. For asphalt pavements, the values of all the parameters tend to increase with age and/or traffic exposure, except in cases where surfaces are contaminated or have deteriorated due to oil spills, asphalt bleeding, or loss of stone projections, etc. (which are undesirable events).

Traditionally, the reflectance matrices are grouped into four or eight classes. The aforementioned CIE-sponsored research in the sixties and seventies has resulted in the recommendation of four basic classes, namely R1, R2, R3, R4 or, alternatively, N1, N2, N3, N4 [4]. The R-classes are the older ones already mentioned in Reference 1, and the N-classes are a more recent proposal. Both systems of classes are evenly spaced and centred with regard to the cases reported in the Erbay Atlas [7], and both are reported in Reference 4.

Frederiksen et al [15] have compared the two classification systems by analysing five parameters of luminance uniformly, concluding that there are smaller deviations from reality by using the R-classes of specularity (compared to the N-classes).

On the whole, the specularity parameters S1 and S2 are somewhat larger for the R-classes. The parameters for both sets of standard surface, R and N, are listed in Table 2.

More recently, the IES has proposed and presented the R-series of classifications [1].

For the purpose of design or research, the standardized reduced luminance coefficients as given in the standard R or N tables, can be scaled up or down by an adjustment factor, to obtain a desired value of Q0 whenever the actual Q0 values (of Table 1) differ from a desired or specified design value. This adjustment amounts to a modification in overall brightness without changing specularity. For instance, the pavement surface represented by Table 1 has a smaller overall brightness (Q0 = 0.074) than the best fitting standard surface N4 (Q0 = 0.08). In a design based on N4, the standard reduced luminance coefficients in the N4 table are multiplied by a modifying factor, 0.074/0.08 = 0.925, achieving a corresponding lower level of overall brightness.

The Erbay Atlas [7] contains 240 measured or calculated matrices of coefficients, carefully numbered and identified, which could be used for a more refined classification.

The pavement surfaces measured in Ontario have been classified in terms of R and N classes, and also with regard to the closest table in the Erbay Atlas, always in terms of S1 and S2 (refer to Tables 3, 4a and 4b).

Finally, it should be noted that the system of four specularity classes (R or N) used for dry pavements leads to RMS errors of about 5% in luminance and about 6 to 9% in uniformity, when comparing designs based on accurate and classified R-tables (Q0 being constant) [15]. These errors are much smaller than the standard deviation of the parameters S1 and S2 within a specularity class.

4/ REFLECTANCE MEASUREMENTS AND PARAMETERS OF ONTARIO PAVEMENTS

4.1/ Parameter Measurements and Observations

Over 400 six-inch (150 mm) core samples were extracted from 36 different types of pavements in order to measure their reflectance properties and to classify Ontario pavements. The photometric instrument used for the measurement of the reflectance matrices is illustrated in Figure 3. The reflectance parameters Q0, S1 and S2 were obtained from the reduced luminance coefficient matrix as measured on each core sample. The final parameters of each pavement type were averaged from at least three core samples and are listed in Tables 3, 4a, 4b and 5, indicating location, pavement type, composition and specularity classes in terms of 'R' and 'N' numbers and the number of the nearest Erbay Atlas [7] matrix table. The detailed mix composition of each pavement type, the core sampling pattern, the traffic volume history and the preliminary statistical analysis are presented in Appendix 'A'.

The comparison of the reflectance parameters of Highway 7 and Highway 401 test sections with those of the standards 'R' and 'N' classes as well as the tables tested in the Erbay Atlas [7] are shown on log S1 vs log S2 graphs in Figures 4 and 5. These graphs indicate that the reflectivity parameter values of Ontario pavements are within the boundary of the Erbay Atlas "cloud" delineated by the dashed line. However, the position of a specific pavement type can vary significantly along the log S1 axis, depending on the condition of the surface texture as seen in Figure 5. It seems that the amount of polishing, wear, aggregate loss and contamination combined with the colour of aggregates all contribute to the magnitude of the S1 and S2 parameters. These factors determine the position on the graph and a corresponding standard classification.

Although the degree of relative contribution to the S1 and S2 values by each of the aforementioned variable factors has not yet been well defined, mainly because of insufficient time-series data, nevertheless, limited observations by the authors of this report in conjunction with information from Reference 15 seem to indicate that parameters S1 and S2 change with time or traffic volume. The changes are not always in the same direction of increasing values, but may go up and sometimes even down, fluctuating within a band of 20 to 25% of S1.

Another observation which stands out particularly with the Lindsay pavement sections is a well-defined relationship between the magnitude of the specularity parameter S1 and the type of coarse aggregate (refer to Figure 4). The Lindsay sections represent a broad range of coarse aggregates ranging from hard and dark trap-rock to brighter and softer limestone as well as the combinations of both. Consequently, the combined effects of different colours and rates of wear have resulted in a well-defined range of S1 values of each aggregate type. The following grouping shows the specific aggregate and its corresponding log S1 value derived from Lindsay data:

Coarse Aggregate	Range of S1
Lime Stone (Soft, Bright)	0.05 to -0.10
Blend of limestone and Trap-rock	-0.08 to -0.23
Trap-rock (Hard, Dark)	-0.17 to -0.29

This grouping can be explained by different resistance to polishing under traffic load.

Figures 6 and 7 represent plots of log S1 versus Q0, similar to Table 9c in Reference 4. In general, these diagrams show a wide scattering of Q0 values, indicating large variations in brightness. More specifically, Figure 6 (the Lindsay test site) reveals the following grouping in terms of coarse aggregates:

Coarse Aggregate	Range of Q0
dark trap-rock	0.074 to 0.088
blend of the two	0.086 to 0.097
bright limestone	0.102 to 0.124

This grouping depends obviously on the brightness of aggregates and perhaps partly on a concurrent specularity increase.

Finally, with regard to Figure 7, representing the Hwy 401 test site, there seems to be a narrow grouping of the open-grade mixes with traprock aggregate (and sand mixes combined). For these pavement types there is a narrow band of Q0 values between 0.061 to 0.069. Otherwise, the Hwy 401 test sections show very large variations in brightness (Q0 = 0.06 to 0.10).

Some results from concrete samples that have been measured are listed in Table 5. Much depending on the prevailing limestone coarse aggregate, the Q0 values are high, ranging from 0.109 to 0.129, including the longitudinally-grooved textures. Note that only lateral grooving seems to reduce the Q0 value to about 0.095, without a significant change in specularity. From "gritty" to "polished" samples there is only a slight increase in Q0, but a major shift in specularity, from R2 to R3.

4.2/ Reduced Luminance Coefficient Matrices

An example of a reduced luminance coefficient matrix is shown in Table 1. The coefficient is a function of β and tan γ. The graphical representation of such matrices is illustrated in Figure 8 (a-g). The plots cover a range which corresponds to a roadway area measured in multiples of the luminaire mounting height H, with the following limits:

- from -4H to +12 H longitudinally
- from 0 to 3H laterally (one side only)

Note that this is half of the space angle by which the value Q0 has been defined in References 2, 4, 5 and 6.

- for all graphs shown, the magnitude of the reduced reflectance coeficient, represented by the vertical co-ordinate z, is normalized using the maximum value found in the four standard 'R' tables. This assures proper relative comparison of the represented R values.

- the transformation of angular co-ordinates (β, tan γ) of the original matrix into rectangular co-ordinates (x,y) is based on the following equations:

$x = H \tan \gamma \cos \beta$

$y = H \tan \gamma \sin \beta$

In particular, Figure 8a to 8d respresent the matrices of the standard "R" tables as given, for instance, in Reference 1. Figures 8e and 8f are typical matrices measured on the Hwy 401 test sections. Their shape is comparable to one of the standard "R" shapes shown to the left or to a shape in between them. This means that there is sufficient similarity between measured and standardized matrices for the traditional way of classification.

However, special attention must be drawn to the shape of the surface shown in Figure 8g, which represents the reduced luminance coefficient matrix of an HL-3 pavement containing limestone coarse aggregate which was extracted from the Hwy 7/Lindsay test seciton No. 15. The aggregate was observed to be highly polished. Although this test section has been nominally classified as "R3" or "N3", the measurements on this surface fall out of the traditional CIE classification system, as there is no provision to take into account the second hump along the longitudinal axis. Such an odd case has not been reported before. If this discovery turns out to be of some importance, it should probably be named the "Ontario Hump", however, the particular pavement does not belong to the preferred standard designs and should be avoided in any case because of low skid resistance (refer to Appendix C). The parameters listed for this pavement have been calculated in the usual way, but probably result in underestimating its specularity. A more suitable class would probably be "R4" or "N4"

In order to illustrate the change that may happen in luminance design calculations when a shift in specularity class occurs (Q0 being constant), Table 7 is presented. It shows the percent differences in maximum, minimum, and average luminance values for each Class, R1, R2, R3, compared to those from using the standard table "R4" as input. The values given in Table 7 are based on a typical example and do not represent maximum possible change.

4.3/ The Effects of Accumulated Traffic

With regard to the time of measurement, a shift can be observed from lower specularity classes to higher ones. A comparison between Table 3 and Table 4(a and b) shows that the Lindsay/Hwy 7 test sections fall into lower classes, mainly, R2 and N3, whereas most Hwy 401 test sections exhibit higher classes, because of the much higher accumulated traffic since construction. Further, on Hwy 401, a shift of specularity can also be observed when going from the "driving" lane to the outer "passing" lane. This shift is typically from Class 2 to 3 or from Class 3 to 4, for both "R" and "N" classifications. At the same time, there is also an increase in brightness of the asphalt pavements with time or traffic accumulation which is reflected in a shift to Q0 values. An attempt has been made to quantify these shifts versus accumulated truck traffic load, which has been estimated at about 0.76 and 19 units of 10 000 000 tons (1000 kg), for the outer passing lane and the driving lane, respectively. The corresponding shift of parameters (i.e., the differences in Q0 and S1) are as follows:

- difference in Q0: 0.01 (approx.)
- difference in S1: 0.3 to 0.6 (range for many types)

Graphical representations of this trend for different pavement types is found in Figures 9 to 11.

5/ REFLECTANCE PARAMETERS AS STATISTICAL VARIABLES

The luminance design method of highway lighting systems requires a knowledge of the average pavement reflectance parameters over the extended road stretches. As it can be seen from data presented in Appendix C, the pavement reflectance properties exhibit random as well as deterministic variations. This heterogeneity of pavement characteristics can be measured in terms of standard deviation of reflectance parameters.

Two scales of heterogeneity have to be distinguished: microscale and macroscale. Microscale heterogeneity is characterised by a fast change of reflectance property from point to point of the pavement due to random texture geometry and random distribution of particles (aggregates, with asphalt) with different surface features. Macroscale is characterized by changes in the average over the microscale reflectance properties from locality to locality.

In order to obtain average reflectance parameters of a pavement, sufficient averaging over each scale has to be accomplished. Futhermore, the analysis of heterogeneity on each scale leads to a better understanding of the factors determining those reflectance properties.

It should be noted that the total variability of data reflects not only the inherent heterogeneity of pavement properties but also the measurement errors although the latter introduce a minor component in total variability of data as explained below (refer also to Table 9).

Several experiments were specially designed and statistical analysis was carried out with the following objectives:
- to select a sample dimension for sufficient averaging over the microscale,
- to select a number of samples to obtain sufficient averaging over the macroscale,
- to separate different components of data variances such as
  - measurement errors
  - microscale heterogeneity
  - macroscale heterogeneity

5.1/ Measurement Errors

Measurement errors can be classified into two groups:

- instrumental errors, which occur due to the following: signal to noise ratio, stability of the power supplies for light sources and detector, and the errors in the automated adjusment to each measurement geometry; and

- measuring technique errors, such as calibration errors, sample positioning and levelling errors, etc.

In an earlier report (Reference 9) the instrumental errors, were estimated and it was shown that the relative errors for reflectance parameters are below 2%. These estimates were carried out on the basis of a small number of measurements.

To establish the measurement errors, two samples from the section of Hwy 401 were selected namely; sample 2-1, from an HL-1 pavement , subjected to a heavy traffic load, and sample 18-1, from an OFC pavement recently constructed. Ten measurements on each sample were carried out with complete readjustment of the instrument for each measurement. (Calibration was done only once for all measurements). The actual data obtained in this experiment are in Reference 17. The results of the analysis of variances are presented as follows:

Q0:	σ = .00167	C.V. = 2.3%
S1:	σ = .0186	C.V. = 1.9%
S2:	σ = .0340	C.V. = 1.5%

where:

σ = standard deviation estimate
C.V. = coefficient of variation in percent.

The measurement errors are very small. As it will be shown later, the inherent heterogeneity of pavement reflectance properties on the macroscale is much larger than the measurement errors, so the latter can be excluded from future analysis.

5.2/ Microscale Heterogeneity

The light reflection at rough surfaces, such as pavements, can be described by modelling the surface as a set of almost flat facets having different optical properties (index of refraction) and different orientation.

The reflection of light towards a certain direction is a sum of specular (mirror-like) reflection by preferably oriented facets and diffuse reflection by all the facets.

The intensity of the specular component in the direction of the receiver is dependent on the amount of facets having preferred orientation as well as on the optical properties of the facets (refraction and absorption) and the incident angle.

The intensity of the diffusive component, which appears due to minute random non-flatness of the facets, depends on the angles of incidence on the surface γ, angle of reflection β, (Figure 2) and the amplitude of minute random deviations from flatness.

In other words the reflection property of the pavement surface in microscale depends on the surface texture and the optical (electromagnetic) property of the components of the mix (asphalt and aggregates) and its distribution. The characteristic dimensions of this distribution are ranging from distances comparable with the wave length of light up to the maximum dimensions equal to the average size of the coarse aggregate $\simeq$ 0.25 cm^2. To average over this range the field of view size was selected to be much larger than the largest characteristic dimensions of microscale, namely 72 cm^2 (approx).

At the same time, as it was mentioned before, the selected sample size is conveniently small for sample collection and laboratory measurements. Thus each R-value presented in Table 1 is an average value over the area of the sample.

In order to prove that sufficient averaging over the microscale non-homogeneity is provided by the selected sample size, the following special experiment was carried out.

From Section 11 in Lindsay nine samples were selected. Each sample was measured in three different ways, i.e., over three different fields of view as shown in Figure 12.

The results of the analysis of the variances for this experiment are presented in Table 8.

The F-test on the 95% confidence level, shows that there is no statistically significant difference between parameter values obtained on the sample size of ≈ 70 cm^2 and ≈ 35 cm^2. So even the smaller sample area of 35 cm^2 provides sufficient averaging on the microscale level.

However, as demonstrated in Table 8, there are statistically significant differences between samples from the same pavement, from different locations. It must be concluded that these differences are due to macroscale non-homogeneity of the pavement surfaces.

5.3/ Macroscale Heterogeneity

The macroscale heterogeneity of the pavement reflectance properties is due to variations in pavement average composition and texture from place to place on the extended road stretches as well as across the road.

The variations of pavement composition and texture can be attributed to the construction process itself and to the patterns of wear and contamination of the pavement surface after exposure to the traffic. The latter can be governed by road geometry (turns, slopes, exits and entrances), by traffic distribution pattern along and across the road, and by environmental damage.

To obtain a sufficient averaging over the macroscale heterogeneity, an a priori estimate of the standard deviation of pavement reflectance property for the particular pavement has to be made. For this estimate, we use the standard deviation obtained from the previous measurements on

20 samples collected on a slightly worn HL-1 pavement. The samples were cored at Downsview Avenue, see Appendix A. In accordance with this a priori estimate three samples were used to find the average value of reflectance parameters along the extended highway stretches.

In order to separate different components of the variance of reflectance parameters on macroscale level several different experimental designs were used, see Appendix A. It should be noted that much more work had to be done to separate influences of different factors affecting macroscale heterogeneity such as mentioned above; construction process, road geometry, traffic load distribution, and environmental damage.

In this work, only the combined effect of different factors has been analysed. The major attention was to close-range (~ 1 m) and long-range (~ 30 m) variations in reflectance property along the highway and to variation of parameters across the highway which can be related to different patterns of wear (wheel path, non-wheel path) and traffic distribution across the lanes.

The results of analysis of data from Section L-11, Hwy 7 are presented in Table 9. In this experiment 27 samples were cored, as shown in Figure A2, Appendix A. The results show that there is no statistically significant difference on 95% confidence level between the close-range and long-range macroscale heterogeneity of reflectance property. Close-range heterogeneity is defined as standard deviation of the reflectance parameters on the distances of about 1 m (5 ft) along highway. The long-range on the distances about 30 m (100 ft).

The reflectance heterogeneity of Q0 along and across the pavement was found to be:

Q0: σ along = .0036 or C.V. ≃ 4.6%
Q0: σ across = .0054 or C.V. ≃ 6.8%

The spread of the specularity parameters S1 and S2 along the pavement section is larger than the spread of Q0, and no significant difference on the 95% confidence level was observed for variations across and along the highway.

So the standard deviation for S1 and S2, which is the measure of heterogeneity, can be obtained from the total variance;

S1: $\sigma = .1298$ C.V. = 20.3%

S2: $\sigma = .1082$ C.V. = 5.6%

The similar analysis, but on more limited data of Section L-15 and L-17 of Hwy 7, support the above observation and estimate of values (see the data in Appendix C).

The above observation was done on a 120 m (400 ft) long section constructed as test-sections, it is probable that for the longer road stretches and for less rigorous quality control during the construction, the long-range variation will prove to be larger than short-range variations.

More detail on the heterogeneity of reflectance data across the pavement were obtained during the analysis of data from test-sections of Hwy 401.

The results of the statistical analysis from Hwy 401 sections are presented in Tables 10 and 11. (See the sampling procedure in Appendix A, Figure A3).

In Table 10 the total variability of the reflectance parameters for each section is presented. The standard deviation σ is, as it was mentioned before, describes the heterogeneity of the pavement surface reflectance properties. As it can be seen from Table 10, the variances along and across the section can be separated in most cases. It is difficult to specify factors affecting the variability along the lane. However, variability across the section are due to two major factors:

- traffic load variations from lane, to lane,
- difference in wear and contamination of wheel-pass and between wheel-pass, being parts of the area of the same lane.

To separate the effect of traffic load, the wheel-pass data have been used exclusively. In Table 11 the variation across the section is mainly due to traffic loads. F-tests show that at 95% confidence level the mean values of parameters for different lanes depend on the load.

Graphs 8-10, to be discussed later, show that the increase of the load tend to increase the reflectance parameters values.

At the same time, there is no statistically significant difference for between wheel-pass reflectance data of different lanes, when analysis of variances is done on the between wheel-pass data exclusively.

The Table 12 summarizes the statistical analyses, which were discussed in this chapter. The total variance of the data is separated by source of variation and the ranges of standard deviations and coefficients of variation for different parameters are presented for each variation sources.

6/ THE INFLUENCE OF CHANGE IN VIEWING ANGLE α

The classification and measurement of reflectance matrices in Europe and now in Ontario was based on a viewing angle of α = 1°. This angle is approximately related to the prevailing, most critical viewing distance of a car driver, namely 80 m to 100 m ahead of his current position. However, truck, bus and van drivers are normally viewing from a more elevated eye level and their critical viewing angle would then be larger than 1°. Drivers of sportscars, on the other hand, may view the road surface from a smaller angle. Further, it would simplify field measurements if the viewing angle of the photometer could be set to a larger value (say 2°). All these factors provide sufficient reason to study the influence of α on the reflectance parameters.

Within the prevailing geometric restrictions of the instrument used for the Ontario measurements it is possible to change the viewing angle α, from 0.75° to 3°. Three samples of 150 mm (6") cores from three different sections (2, 11, 14) of Hwy 401 were selected, and matrices were measured for α = 0.75°, 1°, 1.5°, 2°, 2.5° and 3°. An inspection of the samples showed a somewhat uneven texture and colour, especially for Section 2.

First, the reflection parameters Q0, S1, S2 were plotted versus α in Figures 13, 14, and 15. The following trends can be observed:

Q0: Whereas there is no significant difference between the values for α = 0.75 and for α = 1°, there is a noticeable drop in Q0 at α = 1.5° and even more at α = 2°, up to about 10% and 15%, respectively.

S1: The trend is similar, a drop beyond α = 1, but less severe, Section 2 samples excepted.

S2: This parameter shows a gradual general drop with increasing α of about 5% per degree of α.

Base of values for α = 1° being 100%, the percentage changes for each section were averaged and have been plotted in Figures 13, 14, 15.

The general conclusion is that average brightness (QO) decreases about 10 to 15% for a change in α from 1° to 2°. There is also a noticeable decrease in specularity, but by a smaller amount. These drops seem to level off between 2° and 3°.

7/ CONCLUSIONS AND RECOMMENDATIONS

Over 400 samples of 150 mm (8") diameter have been measured with regard to their light reflectance matrix using the photometer equipment developed at the University of Toronto. The samples represent over 100 pavement types which differ in composition and wear under traffic.

Reflectance parameters, Q0, S1, S2, were established for each type, including their standard deviations as random statistical variables and, as much as possible, their correlations with aggregate properties and traffic exposure. Changes of such parameters with changing viewing angle α, were also studied.

All pavement types were classified in accordance with standard specularity classes:

1/ Classes R1, R2, R3, R4 according to CIE recommendations and IES proposal [1], [4],

2/ Classes N1, N2, N3, N4 according to CIE recommendations [4],

3/ Erbay Atlas Number [7].

With regard to specularity on dry pavement surfaces, design by luminance method based on four classes (N or R) is sufficiently accurate, if an appropriate Q0 value is selected, because within each specularity class, the over-all brightness, Q0, may change considerably.

Generally speaking, for asphalt pavements, reflectance parameters are a function of mix design, especially the coarse aggregate content. The composition of surface courses in conjunction with accumulated traffic load determines the level of all parameters. All parameters increase with accumulated traffic, which means the same road section becomes gradually brighter (Q0) and more specular (S1, S2). The rate of change in specularity depends on the coarse aggregate being more or less soft and polishable, whereas the brightness is a matter of aggregate colour.

More specifically, with regard to the luminance method of design, Table 12 can be consulted for light reflectance parameters, although the table is not to be regarded as complete. This means certain pavement surface materials are not covered, and some further measurements are recommended.

REFERENCES

[1] DeBoer, J.B., Schreuder, D.A., "Public Lighting," Chapter 3, Theoretical Basis of Road Lighting Design, Philips Technical Library, Eindhoven, The Netherlands, 1967.

[2] Sorensen, K. & Nielsen, B., "Road Surfaces in Traffic Lighting," The Danish Illuminating Engineering Laboratory Report No. 9, September 1974.

[3] Road Lighting for Wet Conditions, Publication CIE No. (TC-4.6) 1979.

[4] Calculation and Measurement of Luminance and Illuminance in Road Lighting, CIE Committee TC-4.6, CIE Technical Report TRI, 12/1/75, a Publication CIE No. 30 (TC-4.6), 1976.

[5] Fredriksen, E., "Lighting Quality Under Changing Weather Conditions," International Lighting Review, Vol. XXIII, No. 1, 1972, 14-16.

[6] King, L. Ellis, "Measurement of Directional Reflectance of Pavement Surfaces and Development of Computer Techniques for Calculating Luminance," Journal of the Illuminating Engineering Society, Vol. V, No. 2, January 1976, 118-126.

[7] Erbay, A., Atlas of the Reflection Properties of Road Surfaces, Institut für Lichttechnik der Technischen, Universitat Berlin, 1974.

[8] Jung, F.W. et al, Computer Program for Fixed Highway Lighting, Ontario Ministry of Transportation and Communications, Downsview, Ontario, 1975.

[9] Bassett, M.G., Dmitrevsky, S., Kremer P.C., and Jung, F.W., "Measurement of Reflection Properties of Highway Pavement Samples," accepted for publication in the Journal of the Illuminating Engineering Society, on September 14, 1981.

[10] Kamel, N.B., Corkhill, J.T., and Musgrove, G.R., Bituminous Friction Course Sections at Lindsay, Ontario, Report MSR-80-002, Ministry of Transportation and Communications, Downsview, Ontario, 1980.

[11] Jung, F.W. et al, "Luminance of Road Surfaces for Fixed Highway Lighting Design and the Ontario Road Reflectance Matrix Photometer," RTAC Paper, 1982.

[12] Sorensen, Kai, "Description and Classification of Light Reflectance Properties of Road Surfaces," The Danish Illumination Engineering Laboratory, Report 7, January 1974.

[13] Ryell, T., Corkill, J.T., Muskrove, G.R., Skid Resistance of Bituminous Pavements Tests Sections, Highway 401 Toronto by Pass, Transportation Research Board, January 1979.

[14] Karnel, N., Musgrove, G.R., Design and Performance of Bituminous Friction Course Mixes in Ontario, Gulf Canada Limited, Sheridan Park, Ontario, September 1981.

[15] Fredriksen, F., Sorensen, K., "Reflection Classification of Dry and Wet Roadway Surfaces," Danish Illumination Engineering Laboratory, Volume 8, No. 4, August 1976.

[16] JES Roadway Lighting Committee, Schwab, R.N., Young, S.H., "Proposed American Standard Practice for Roadway Lighting," IES Journal, V. 12, No. 3, April 1983, P. 146 ff.

[17] University of Toronto four volumes.

[18] Vermeuleu, J., "Light Reflection from Rough Surfaces," CIE International Commission on Illumination, Proceedings, p. 659, London, 1975.

Table 1/ Typical Print-Out of a Light Reflectance Matrix

DATE: MARCH 15/83
IDENTIFICATION: 14-1 Open Grade Mix, 67% coarse aggregate, 5.8% asphalt, Hwy 401 test section.

BETA →

tan GAMMA	0	2	5	10	15	20	25	30	35	40	45	60	75	90	105	120	135	150	165	180
0	2713	2760	2760	2742	2713	2760	2713	2754	2807	2760	2760	2848	2854	2789	2836	2807	2754	2760	2742	2742
.25	3319	3325	3325	3307	3325	3272	3230	3230	3183	3125	3072	2901	2795	2648	2471	2383	2318	2224	2177	2242
.5	3789	3731	3778	3731	3601	3495	3325	3183	3089	2895	2795	2430	2148	1954	1820	1759	1711	1679	1650	1628
.75	4078	4160	4078	3842	3654	3401	3025	2801	2477	2277	2163	1783	1556	1388	1298	1217	1208	1208	1209	1203
1	4219	4248	4160	3748	3325	2836	2430	2130	1834	1647	1481	1195	1005	944	861	845	837	859	850	856
1.25	4295	4213	4078	3554	2807	2242	1787	1506	1302	1137	996	795	719	677	653	625	653	621	645	645
1.5	4342	4219	3936	3089	2283	1675	1289	1039	885	785	713	577	525	484	475	478	456	494	484	503
1.75	4172	4060	3554	2560	1754	1256	913	757	653	560	522	422	393	367	360	374	376	380	386	398
2	4031	3842	3213	2130	1292	878	673	540	461	419	375	324	310	291	287	301	301	304	319	324
2.5	3654	3460	2471	1278	732	492	384	315	263	254	235	221	208	210	210	212	202	224	216	230
3	3325	2989	1830	790	437	277	243	219	194	183	189	165	148	158	149	163	164	174	183	189
3.5	3042	2424	1275	489	266	214	170	151	154	151	135	120	112	119	119	112	131	132	141	139
4	2789	2101	927	329	203	148	124	144	129	118	106	99.1	86.8	90.3	94.9	98.3	99.1	119	127	121
4.5	2477	1706	672	249	153	112	99.1	86.5	106	100	84.6	76.6	78.8	80.2	84.6	89.6	93.4	94.1	180	106
5	2336	1463	492	194	114	90.1	84.6	75.1	76.5	84.0	76.6	68.2	63.3	72.9	70.8	78.8	79.3	88.4	91.6	95.3
5.5	2164	1162	376	154	95.0	83.8	73.2	64.4	64.4	63.0										
6	2024	950	282	117	83.5	67.7	68.5	63.0	58.6											
6.5	1904	751	236	97.4	74.6	68.6	58.8	57.8												
7	1745	629	204	84.6	65.3	60.9	55.0	54.5												
7.5	1725	550	175	73.2	64.2	56.2	47.9													
8	1557	456	141	65.3	55.5	52.5	50.2													
8.5	1517	386	126	66.1	53.9	45.4	48.3													
9	1401	351	102	61.9	48.8	45.5														
9.5	1330	309	101	56.2	48.7	47.9														
10	1231	263	85.6	59.2	47.3	44.6														
10.5	1241	253	78.0	56.3	47.8	47.0														
11	1138	201	78.8	50.1	44.6	42.3														
11.5	1090	197	73.3	52.6	43.7															
12	1076	194	65.8	49.3	42.8															

X 100000

Q0 = .0737384
S/1 = 1.48577
S/2 = 2.7178
R(0,0) = .0271316
R(0,2) = .0403113

MODIFIED VALUES:

S/1 = 1.46331
S/2 = 2.66294
R(0,0) = .0276906
R(0,2) = .0405197

Table 2/ Parameter Values of Standard Surfaces, R & N Series

Parameter	R-Series				N-Series			
	R1	R2	R3	R4	N1	N2	N3	N4
Q0	0.10	0.07	0.07	0.08	0.10	0.07	0.07	0.08
S1	0.25	0.58	1.11	1.55	0.18	0.41	0.88	1.61
S2	1.53	1.80	2.38	3.03	1.30	1.48	1.98	2.84

Table 3/ Reflectance Parameters of Hwy 7 Test Sections (Lindsay)

LOCATION, TYPE AND MIX COMPOSITION (%)					REFLECTANCE PARAMETERS			SPECULARITY CLASSES		NEAREST ERBAY TABLE
SECT. No.	PAVEMENT	AGE (YRS)	COARSE AGGREG.	FINE AGGREG.	Q0	S1	S2	R	N	Number
1	O.G.	5	58 MR	35 MRS*	0.0744	0.6623	1.9457	2	3(2)	149
2	O.G.	5	61 LS	35 MRS*	0.1019	0.8814	2.0171	2	3	164
3	P.G	5	61 MR&LS	35 MRS*	0.0887	0.7805	1.9875	2	3	157
4	O.G	5	58 MR&LS	35 MRS*	0.0947	0.8289	2.0058	2	3	165
5	O.G.	5	58 LS	35 LSS	0.1125	0.8586	1.9732	2	3	164
6	O.G.C.	5	59 LS	35 LSS	0.0821	0.5911	1.8119	2	2(3)	136
7	D.F.C	5	54 LS	45 S	0.1135	0.9804	2.0997	2	3	178
8	D.F.C.	5	52 LS	45 BLEND	0.1146	0.8899	2.0375	2	3	167
9	D.F.C.	5	52 LS	45 BLEND	0.1066	0.9608	2.1192	2(3)	3	178
10	D.F.C	5	52 LS	45 MRS	0.1061	0.7990	2.0396	2	3	157
11	D.F.C.	5	52 MR	45 MRS	0.0791	0.6376	1.9476	2	3(2)	143
12	D.F.C.	5	53 MR	45 LSS	0.0858	0.5425	1.8352	2	2	127
13	D.F.C	5	52 BLEND	45 LSS	0.0969	0.6877	1.9254	2	3	149
14	D.F.C.	5	52 LS	45 LSS	0.1155	0.9660	2.0436	2	3	171
15	HL-3	5	45 LS	55 S	0.1242	1.1288	2.3490	3	3	186
16	DELUGRIP	5	60 BLEND	35 MRS	0.0858	0.5988	1.9103	2	2(3)	140
17	HL-1	5	45 TR	55 S	0.0879	0.5193	1.8068	2	2	125

LEGEND:
* -- WASHED
O.G. -- OPEN GRADE
D.F.C. -- DENSE FRICTION COARSE

MR -- MAPLE RIDGE
LS -- BEAMISH (BROWN) LIMESTONE
TR -- HAVELOCK TRAP-ROCK
MRS -- MAPLE RIDGE SCREENINGS
LSS -- LIMESTONE SCREENING
S -- ORMELL SAND

Table 4a/ Reflectance Parameters of Hwy 401 Test Sections

LOCATION, TYPE AND MIX COMPOSITION (%)						REFLECTANCE PARAMETERS			SPECULARITY CLASSES		NEAREST ERBAY TABLE
SECT. No	PAV'T	AGE (YRS)	COARSE AGGREG.	FINE AGGREG.	LANE	Q0	S1	S2	R	N	Number
1	HL-1	8	45 TR	41 NS 14 LS	DRIVING	0.0875	1.0553	2.4168	3	3	197
					CENTRE	0.0845	1.1937	2.5148	3	3	195
					PASSING	0.0919	0.7013	2.1601	3(2)	3	148
2	HL-1	8	45 TR	41 NS 14 TRS	DRIVING	0.0962	1.3114	2.7968	4(3)	4(3)	200
					CENTRE	0.0888	1.3491	2.6985	3	4(3)	202
					PASSING	0.0818	0.6646	2.0795	2	3(2)	145
3	HL-1	8	45 TR	55 TRS	DRIVING	0.0696	0.7532	2.2817	3	3	156
					CENTRE	0.0714	0.7863	2.2428	3	3	160
					PASSING	0.0708	0.5868	2.0908	2	2(3)	137
4	HL-1	8	55 TR	34 NS 11 LS	DRIVING	0.0775	1.1883	2.6601	3	3	195
					CENTRE	0.0738	0.9037	2.2916	3	3	169
					PASSING	0.0748	0.6203	2.0066	2	3(2)	145
5	HL-1	8	60 TR	28 NS 10 LS	DRIVING	0.0774	0.8829	2.2766	3	3	169
					CENTRE	0.0749	0.9179	2.3568	3	3	174
					PASSING	0.0745	0.4992	1.9236	2	2	118
6	HL-1	8	60 TR	38 TRS	DRIVING	0.0656	1.4944	2.7842	4(3)	4	207
					CENTRE	0.0632	1.5247	2.6752	3	4	212
					PASSING	0.0620	1.2059	2.4144	3	3	194
7	MODIFIED HL-1	8	45 LS	55 SLS	DRIVING	0.0774	0.6631	2.4803	3	3(2)	151
					CENTRE	0.0704	0.7604	2.4639	3	3	160
					PASSING	0.5974	0.0654	2.1512	3(2)	2(3)	137
8	MODIFIED HL-1	8	50 SL	38 NS 12 L	DRIVING	0.0841	1.9061	3.3580	4	4	225
					CENTRE	0.0798	1.6745	3.0357	4	4	215
					PASSING	0.0736	1.6503	2.8793	4	4	216
9	MODIFIED HL-1	8	45 BF	55 BFS	DRIVING	0.0812	0.6129	2.0031	2	3(2)	140
					CENTRE	0.0737	0.5665	1.9588	2	2	134
					PASSING	0.0788	0.5290	1.8862	2	2	125
10	MODIFIED HL-1	8	40 BF	45 NS 15 LS	DRIVING	0.0934	1.1418	2.7321	3	3	192
					CENTRE	0.0866	1.0565	2.5498	3	3	184
					PASSING	0.0866	0.7446	2.1071	2	3	153

LEGEND: COARSE AGGREGATE
TR -- TRAP-ROCK
SL -- STEEL SLAG
BF -- BLAST FURNACE SLAG

FINE AGGREGATE
SLS -- STEEL SLAG SCREENINGS
LS -- LIMESTONE SCREENINGS
TRS -- TRAP-ROCK SCREENINGS
BFS -- BLAST FURNANCE SCREENINGS
NS -- NATURAL SAND

Table 4b/ Reflectance Parameters of Hwy 401 Test Sections (cont'd)

LOCATION, TYPE AND MIX COMPOSITION (%)						REFLECTANCE PARAMETERS			SPECULARITY CLASSES		NEAREST ERBAY TABLE
SECT. No	PAV'T	AGE (YRS)	COARSE AGGREG.	FINE AGGREG.	LANE	Q0	S1	S2	R	N	Number
11	SAND MIX	8	14 TR	84 TRS	DRIVING	0.0673	1.4215	2.9109	4	4	204
					CENTRE	0.0655	1.2502	2.7779	4	3	198
					PASSING	0.0614	1.1994	2.7355	3(4)	3	192
12	SAND	8	9 TR	89 TRS	DRIVING	0.0691	1.2944	2.8359	4	3(4)	200
					CENTRE	0.0659	1.1170	2.6160	3	3	190
					PASSING	0.0646	0.9624	2.3550	3	3	174
13	OPEN GRADE	8	67 TR	33 TRS	DRIVING	0.0674	1.4182	2.8718	4	4	204
					CENTRE	0.0669	1.5510	2.9015	4	4	211
					PASSING	0.0656	1.1693	2.5874	3	3	190
14	OPEN GRADE	8	67 TR	31 TRS	DRIVING	0.0646	1.4286	2.7329	3(4)	4	207
					CENTRE	0.0624	1.3612	2.6552	3	4(3)	202
					PASSING	0.0611	1.0972	2.3352	3	3	186
15	OPEN GRADE	8	30 TR	70 TRS	DRIVING	0.0750	1.7050	3.2041	4	4	215
					CENTRE	0.0686	1.5377	2.8701	4	4	211
					PASSING	0.0655	1.0616	2.5457	3	3	184
16	OPEN GRADE	8	30 TR	68 TRS	DRIVING	0.0673	1.2342	2.8069	4(3)	3	198
					CENTRE	0.0613	1.1412	2.5527	3	3	190
					PASSING	0.0611	0.9703	2.4239	3	3	179
17	MASTIC	8	70 LS	19 SLS	DRIVING	0.0629	1.4552	2.6720	3	4	207
					CENTRE	0.0647	1.3673	2.5713	3	4(3)	202
					PASSING	0.0658	1.2484	2.5214	3	3	197
1 & 19	HL-1	8	45 BF	41 NS	DRIVING	0.0817	1.8504	3.1227	4	4	224
					CENTRE	0.0752	1.6846	2.9403	4	4	216
					PASSING	0.0743	1.3179	2.6698	3	4(3)	202
18	OPEN GRADE	1/2			DRIVING	0.0610	0.6555	2.0780	2	3	145
					CENTRE	0.0613	0.6234	2.0760	2	3(2)	145
					PASSING	0.0618	0.7702	2.0627	2	3	157

LEGEND:	COARSE AGGREGATE	FINE AGGREGATE
	TR -- TRAP-ROCK	SLS -- STEEL SLAG SCREENINGS
	SL -- STEEL SLAG	LS -- LIMESTONE SCREENINGS
	BF -- BLAST FURNACE SLAG	TRS -- TRAP-ROCK SCREENINGS
		BFS -- BLAST FURNANCE SCREENINGS
		NS -- NATURAL SAND

Table 5/ Reflectance Parameters of Concrete Samples from Hwy 405

LOCATION, TYPE AND MIX COMPOSITION (%)					REFLECTANCE PARAMETERS			SPECULARITY CLASSES		NEAREST ERBAY TABLE
SECT. No.	PAVEMENT	AGE (YRS)	COARSE AGGREG.	FINE AGGREG.	Q0	S1	S2	R	N	Number
1, #2	even concrete polished	15	LS	PRS	0.1235	1.294	2.676	3	3(4)	200
1, #3	even concrete gritty	15	LS	PRS	0.1093	0.473	1.875	2	2	114
2, #2	concrete longitud'l grooving	15	LS	PRS	0.1291	1.318	2.267	3	4(3)	201
2, #2	concrete lateral grooving	15	LS	PRS	0.0945	0.906	2.249	3	3	169
3, #2	concrete longitud'l grooving	15	LS	PRS	0.1244	1.333	2.461	3	4	202
3, #2	concrete lateral grooving	15			0.0958	1.324	2.625	3	4	202
4, #2	concrete rough bridge deck	15	LS	PRS	0.1206	1.264	2.092	2(3)	3(4)	196

LEGEND: LS -- LIMESTONE
PRS -- PIT-RUN SAND

Table 6/ Percent Luminance Change

	STANDARD SPECULARITY CLASS			
Lighting Design Criteria	R4	R3	R2	R1
Average Luminance	0	+ 3.3	+ 4.6	+ 7.5
Maximum Luminance	0	+ 1.1	+13.9	+16.8
Minimum Luminance	0	+ 0.7	+ 6.5	+ 7.8

Table 7/ Comparison of Micro and Macro Scale Heterogeneity

Parameter	Source of Variation	D.F.	Mean Square	F
Q0	1) Between Samples	8	0.000092	3.407
	2) Between Measurement on different area sizes	2	0.0000052	1.926
	3) residual	16	0.0000027	
S1	1	8	0.06187	18.881
	2	2	0.003084	1.066
	3	16	0.003288	
S2	1	8	0.01885	3.91
	2	2	0.001738	0.3609
	3	16	0.004814	

Table 8/ Comparison of the Close- and Long-Range Heterogeneity

Parameter	Source of Variation	D.F.	Mean Square	F	F as %
Q0	1. Close-range (residuals)	22	0.0000137		
	2. Long-Range	2	0.0000121	.4	3.40
	3. Across the pavement	2	0.0001007	7.459	3.40
S1	1	22	0.1644		
	2	2	0.139084	<1	
	3	2	0.0242	1.47	3.40
S2	1	22	0.00975		
	2	2	0.0201	2.06	3.40
	3	2	0.0248	2.54	3.40

Table 9/ Heterogeneity Parameters for Hwy 401

Section #	Parameter	SOURCE OF VARIATION					
		*Along the Highway		* Across the Highway		** Total Variation	
		σ	C.V.(%)	σ	C.V.(%)	σ	C.V. (%)
1	Q0					0.006870	7.8
	S1					0.3613	36.7
	S2	0.1868	7.9	0.1684	7.1		
2	Q0	0.005850	6.5	0.008070	11.0		
	S1	0.2333	21.1	0.3233	29.2		
	S2	0.2141	8.5	0.3402	13.5		
3	Q0					0.004324	6.1
	S1					0.1300	18.3
	S2					0.1284	5.8
4	Q0					0.004195	5.6
	S1	0.1882	20.8	0.2643	29.2		
	S2	0.1683	7.3	0.2814	12.2		
5	Q0					0.06293	8.3
	S1					0.3431	46.8
	S2					0.3783	17.3
6	Q0					0.005177	8.1
	S1					0.2577	18.3
	S2					0.2462	9.4
7	Q0	0.003195	4.5	0.005208	7.3		
	S1					0.1173	17.4
	S2	0.1293	5.4	0.1717	7.3		
8	Q0					0.007759	9.8
	S1	0.2626	15.1	0.2923	16.8		
	S2	0.2447	7.9	0.3935	12.7		
9	Q0	0.004037	5.2	0.003985	5.1		
	S1	0.05495	9.6	0.05938	10.4		
	S2	0.06800	3.5	0.06845	3.5		
10	Q0					0.005422	6.1
	S1	0.1115	11.4	0.1415	19.5		
	S2	0.1215	4.9	0.3358	13.6		
11	Q0	0.004445	6.9	0.004915	7.6		
	S1	0.1406	10.9	0.1356	10.5		
	S2					0.2845	10.1
12	Q0	0.003448	5.2	0.004039	6.1		
	S1	0.08400	7.5	0.2021	18.0		
	S2	0.1552	5.9	0.2720	10.5		
13	Q0	0.003574	5.4	0.003266	4.8		
	S1	0.15400	11.2	0.1721	12.5		
	S2	0.1069	3.8	0.1864	6.7		

(Cont'd) Table Heterogeneity Parameters for Hwy 401

Section #	Parameter	SOURCE OF VARIATION					
		*Along the Highway		* Across the Highway		** Total Variation	
		σ	C.V.(%)	σ	C.V.(%)	σ	C.V. (%)
14	Q0	0.004032	6.4	0.005332	8.5		
	S1	0.1032	8.0	0.1624	12.6		
	S2	0.09251	3.6	0.2010	7.8		
15	Q0	0.006175	8.9	0.005940	8.5		
	S1	0.1717	12.0	0.2933	20.4		
	S2	0.1221	4.2	0.3210	11.2		
16	Q0	0.003476	5.5	0.003457	5.5		
	S1					0.2280	20.4
	S2	0.2321	8.8	0.2173	8.4		
17	Q0					0.004450	6.9
	S1					0.2011	14.8
	S2					0.1768	6.8
18	Q0						
	S1						
	S2						
19	Q0	0.007023	9.1	0.01028	13.3		
	S1	0.2185	13.5	0.3470	21.4		
	S2	0.2540	8.7	0.3278	11.3		

Table 10/ Hwy 401, WP Heterogeneity Parameters, Traffic Effects

Section #	Parameter	SOURCE OF VARIATION					
		*Along the Highway		* Across the Highway Traffic Effect		** Total Variation	
		σ	C.V.(%)	σ	C.V.(%)	σ	C.V. (%)
1	Q0					0.005301	6.1
	S1					0.4279766	39.0
	S2	0.1985	8.4	0.2678	11.2		
2	Q0	0.005838	6.5	0.008071	11.0		
	S1	0.2445	22.3	0.3625	33.1		
	S2	0.2398	9.6	0.4313	17.4		
3	Q0					0.004053	5.6
	S1	0.05331	7.3	0.12795	17.4		
	S2	0.06601	3.0	0.1056	4.9		
4	Q0					0.004669	6.1
	S1	0.1733	17.8	0.3916	40.3		
	S2	0.1373	6.0	0.3650	16.0		
5	Q0	0.004287	5.6	0.005038	6.6		
	S1	0.1301	17.8	0.1910	26.1		
	S2					0.1854	8.4
6	Q0					0.005099	7.7
	S1					0.2902	20.1
	S2	0.1974	7.5	0.2441	9.3		
7	Q0	0.002896	4.1	0.006735	9.5		
	S1	0.08625	12.8	0.1027	15.2		
	S2	0.09429	4.1	0.2120	9.2		
8	Q0					0.009675	12.3
	S1					0.2543	17.3
	S2					0.3795	13.6
9	Q0	0.002946	3.7	.005732	7.2		
	S1	0.04237	7.1	.09009	15.1		
	S2	0.04691	3.5	.08733	4.6		
10	Q0					0.006042	6.8
	S1	0.09784	10.7	0.2226	24.3		
	S2	0.09441	4.1	0.3177	13.8		
11	Q0	0.001649	2.5	0.007721	11.6		
	S1	0.1179	9.6	0.2151	17.4		
	S2	0.1721	6.4	0.2387	8.9		
12	Q0	0.003361	4.9	0.004909	7.1		
	S1	0.04025	4.0	0.2382	23.4		
	S2	0.1171	4.7	0.3352	13.6		
13	Q0					0.005128	7.5
	S1	0.18270	13.0	0.2625	18.6		
	S2	0.09792	3.6	0.2144	7.9		

(cont'd) Table 10/ Hwy 401, WP* Heterogeneity Parameters, Traffic Effects

Section #	Parameter	SOURCE OF VARIATION					
		*Along the Highway		* Across the Highway Traffic Effect		** Total Variation	
		σ	C.V.(%)	σ	C.V.(%)	σ	C.V. (%)
14	Q0	0.004060	6.1	0.005491	8.2		
	S1	0.06721	5.2	0.9557	19.7		
	S2	0.04776	1.9	0.2535	10.1		
15	Q0	0.008069	11.1	0.008321	11.4		
	S1	0.1263	8.9	0.4108	29.1		
	S2	0.1022	3.7	0.4093	14.8		
16	Q0	0.002001	3.1	0.005659	9.5		
	S1					0.2353	23.2
	S2	0.1666	6.8	0.1969	8.1		
17	Q0					0.004439	6.8
	S1					0.1614	11.3
	S2					0.1078	8.4
18	Q0						
	S1						
	S2						
19	Q0	0.005304	6.4	0.01213	14.6		
	S1	0.2329	13.6	0.5401	31.5		
	S2	0.2586	8.8	0.5338	18.1		

* Wheel Path

Table 11/ Categories of Statistical Variation

Source of Variation	Parameter	Range of r	Range of C.V. (%)
Measurement Errors	Q0	0.0017	2.3
	S1	0.019	1.9
	S2	0.34	1.5
Microscale Heterogeneity	Q0	0.00182	1.7
	S1	0.0572	9.0
	S2	0.0669	3.6
Macroscale Heterogeneity			
Along the Highway	Q0		
	S1		
	S2		
Across the Highway	Q0		
	S1		
	S2		

Table 12/ Recommended Design Values for Southern Ontario Pavements

COMPOSITION	R or N CLASS	BRIGHTNESS
steel slag, open grade	R2, N3, R3	Q0 = 0.06
trap-rock, open grade	R3, R4	Q0 = 0.07
blend of igneous & lime, open grade	N3	Q0 = 0.09
limestone, open grade	N3	Q0 = 0.10
steel slag, dense friction course	R4 or N4	Q0 = 0.075
blast furnace slag, dense friction course	R2 or N2	Q0 = 0.075
trap-rock, dense friction course	R2, N3, R3	Q0 = 0.065
blend of igneous & lime, dense f.c.	R3 or N3	Q0 = 0.085
limestone, dense friction course	R2, N2, R3, N3	Q0 = 0.10
concrete limestone plain	R3 or N3 old: R4	Q0 = 0.12
concrete limestone lateral grooves	R3 or N3 old: R4	Q0 = 0.095

NOTE: The higher specularity class is valid for older pavements.

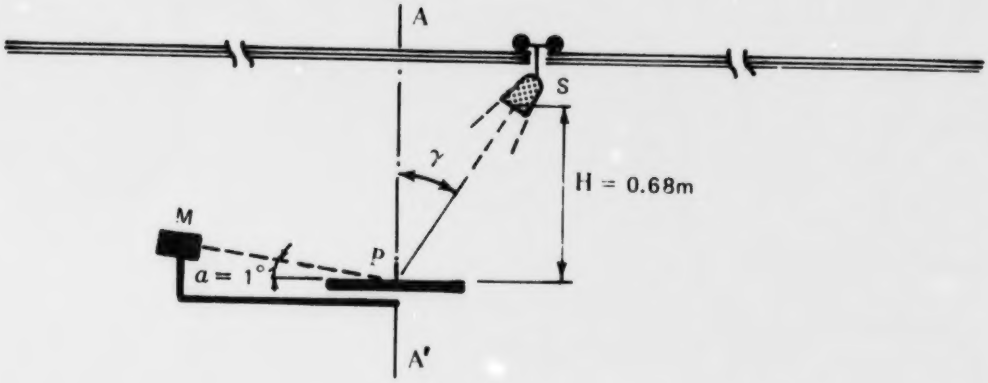


Figure 1/ Principle of an Experimental Set-up for the Measurement of the Reflection Properties of Road Surfaces

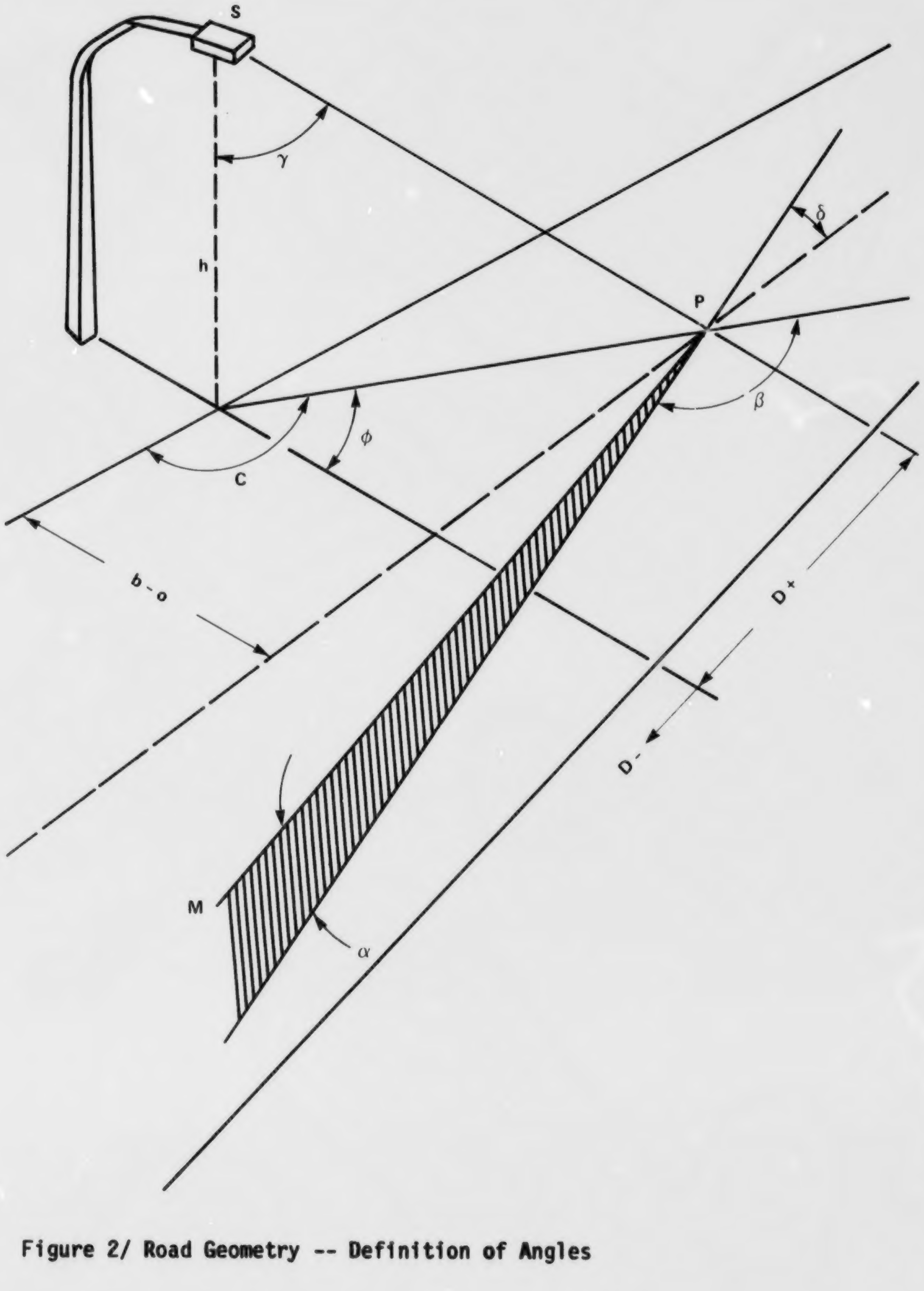


Figure 2/ Road Geometry -- Definition of Angles

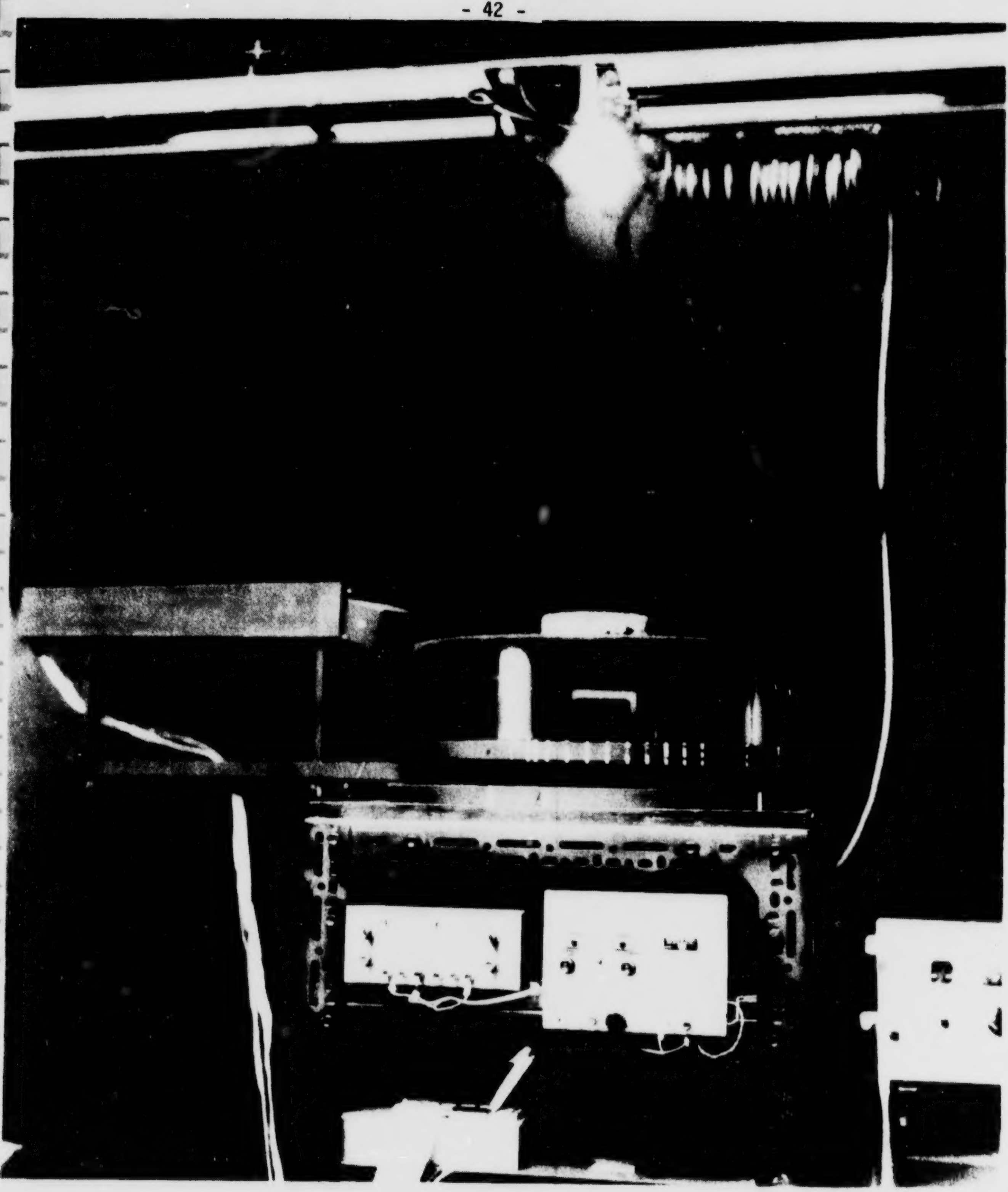


Figure 3/ Photograph of Equipment -- The Reflectance Matrix Photometer

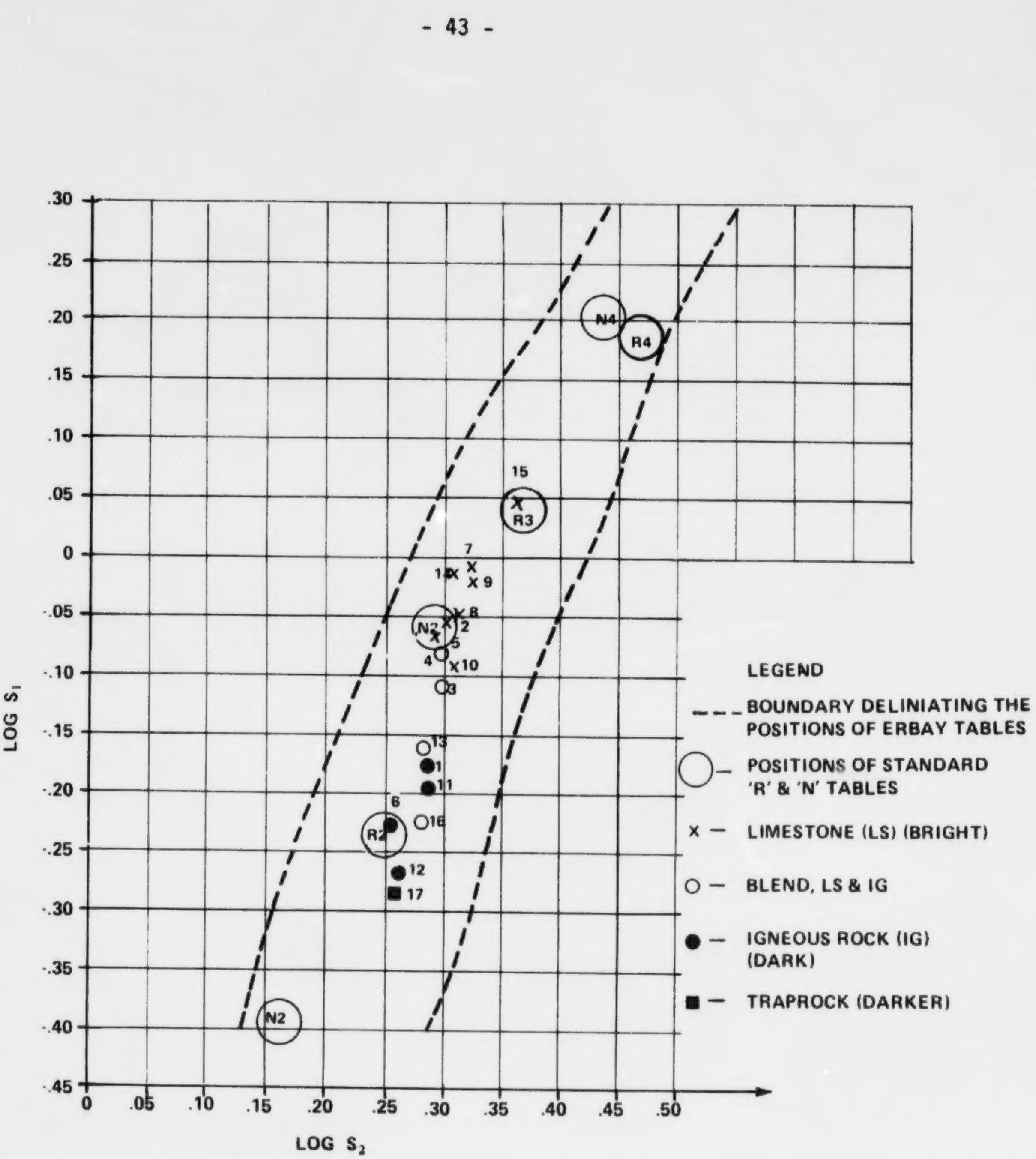


Figure 4/ Specularity Plot of Lindsay -- Hwy 7 Test Sections (Log S1 vs Log S2)

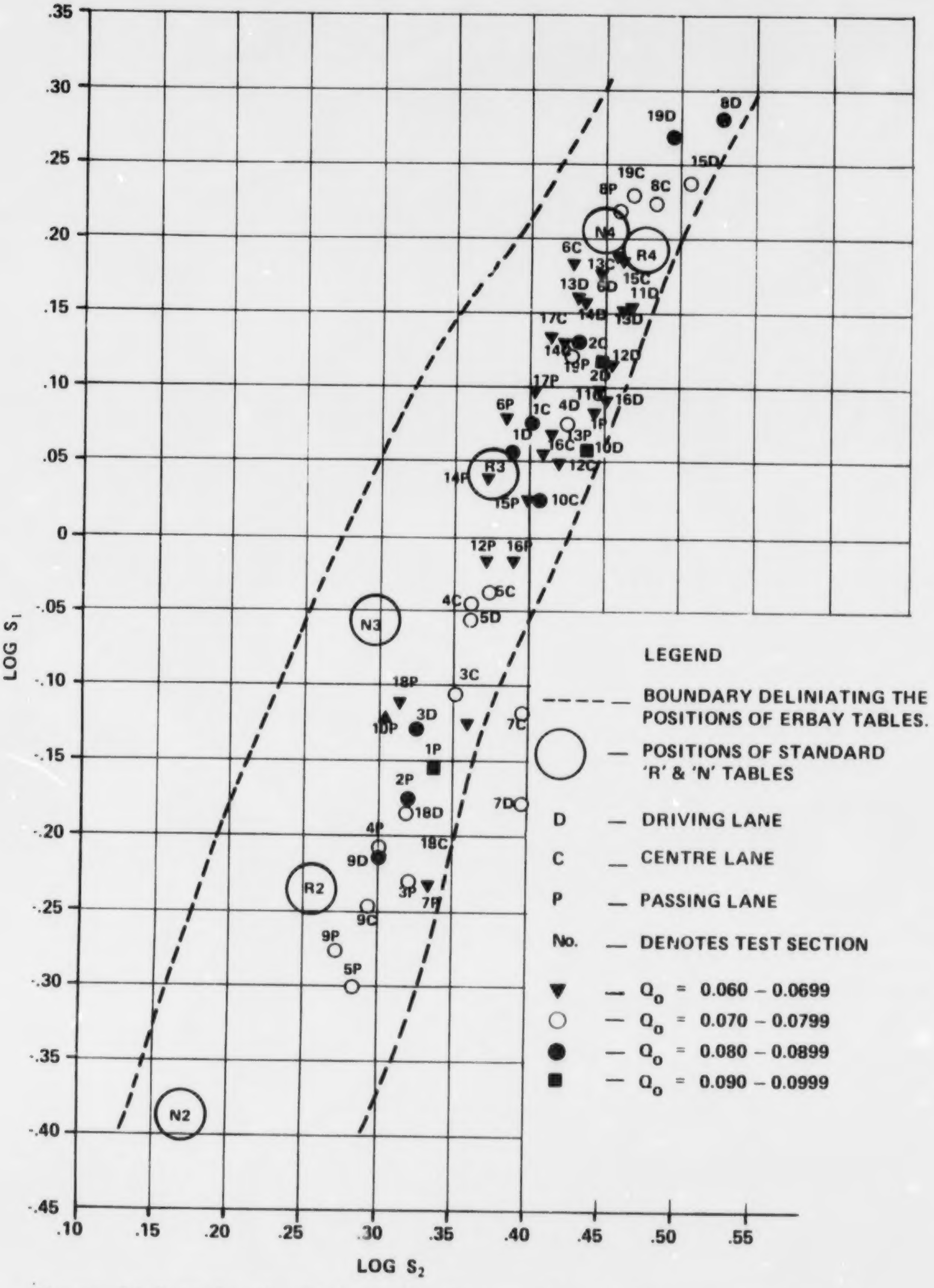


Figure 5/ Specularity Plot of Hwy 401 -- Toronto Bypass Test Sections (Log S1 vs Log S2)

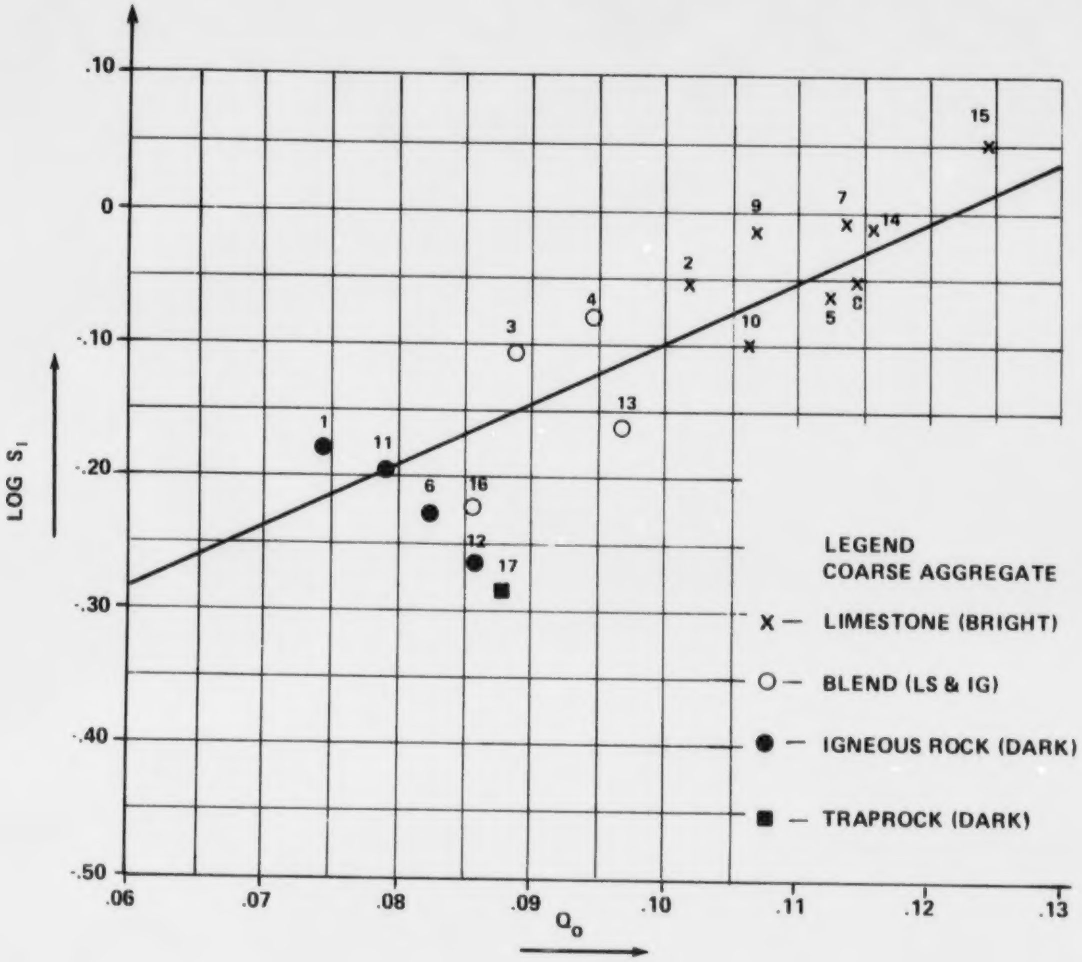


Figure 6/ Brightness -- Specularity Diagram for Lindsay -- Hwy 7 Test Sections (Log S1 vs QO)

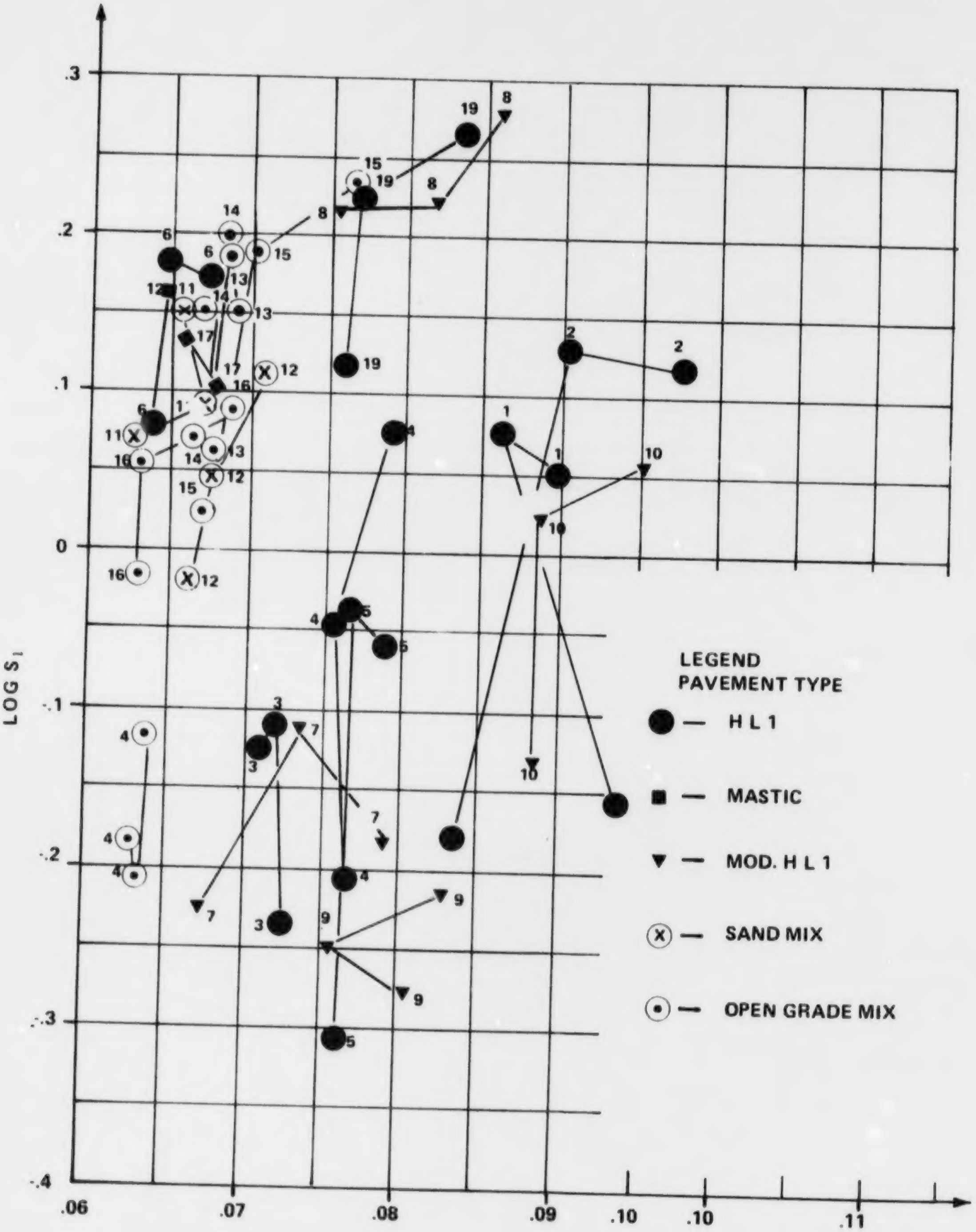


Figure 7/ Brightness -- Specularity Diagram for Hwy 401 -- Toronto Bypass Test Sections (Log S1 vs Q0)

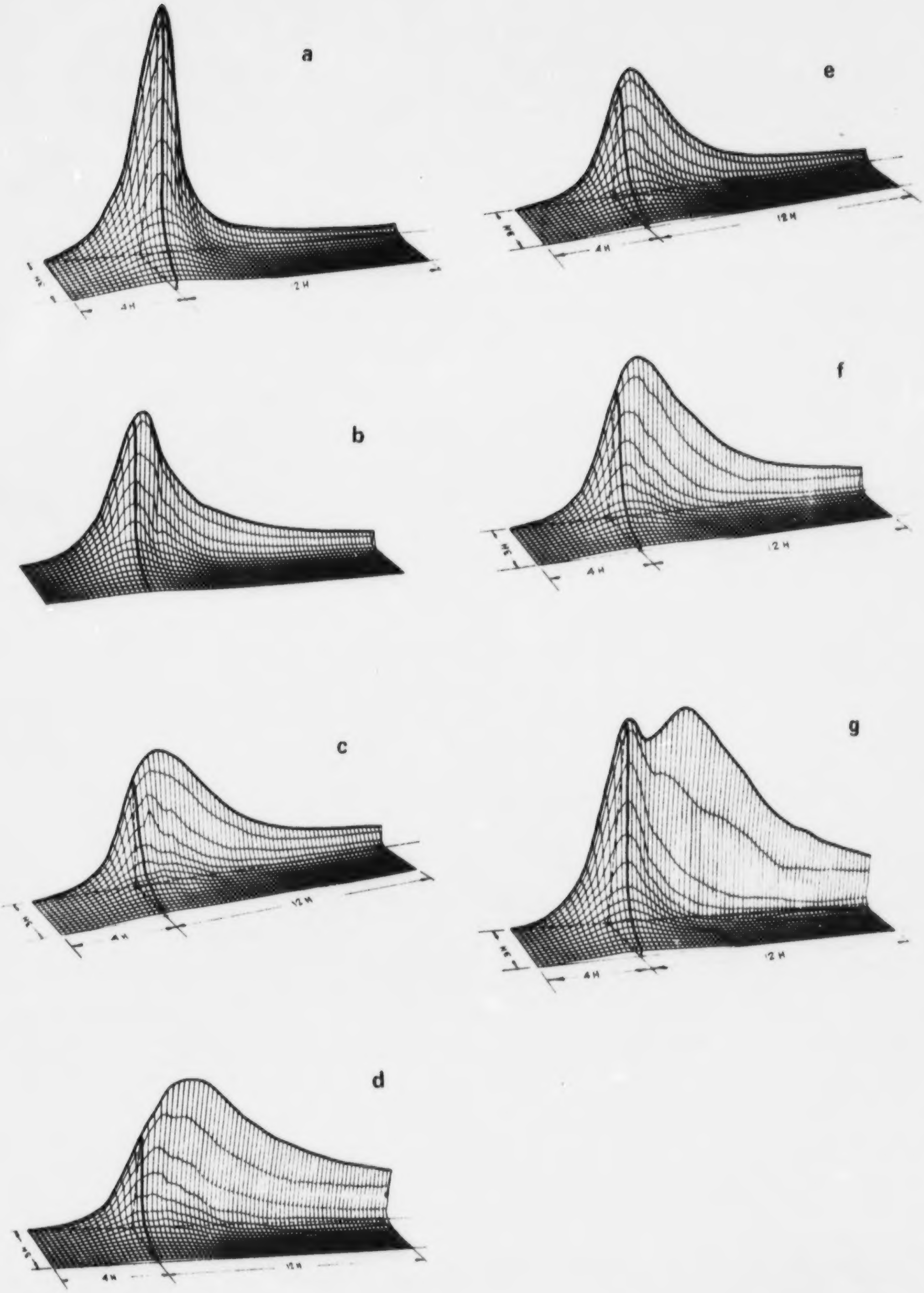


Figure 8/ Visual Representations of Reflectance Matrices

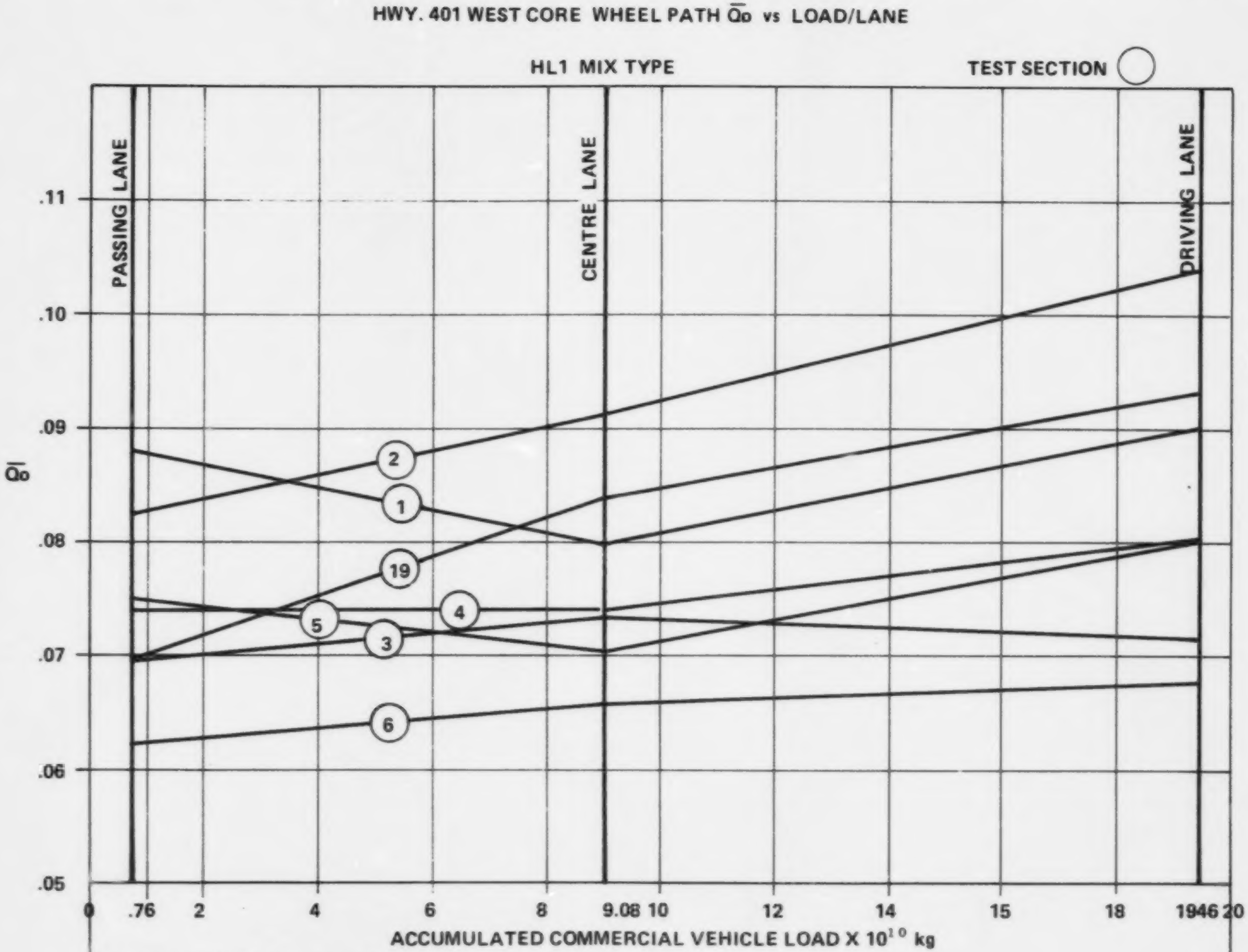


Figure 9a/ QO vs Traffic Load -- HL-1 Mixed Type

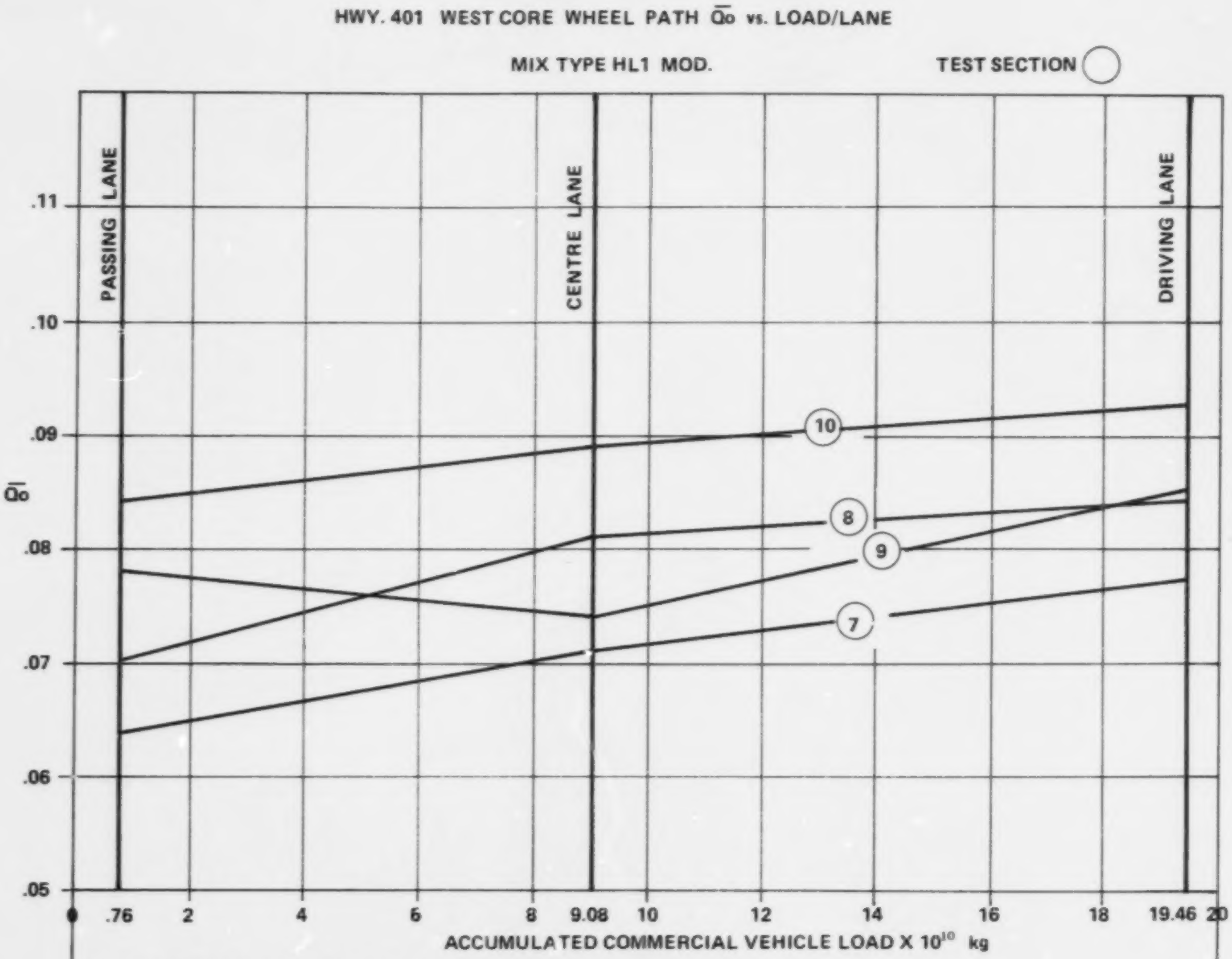


Figure 9b/ QO vs Traffic Load -- HL-1 Mod. Mixed Type

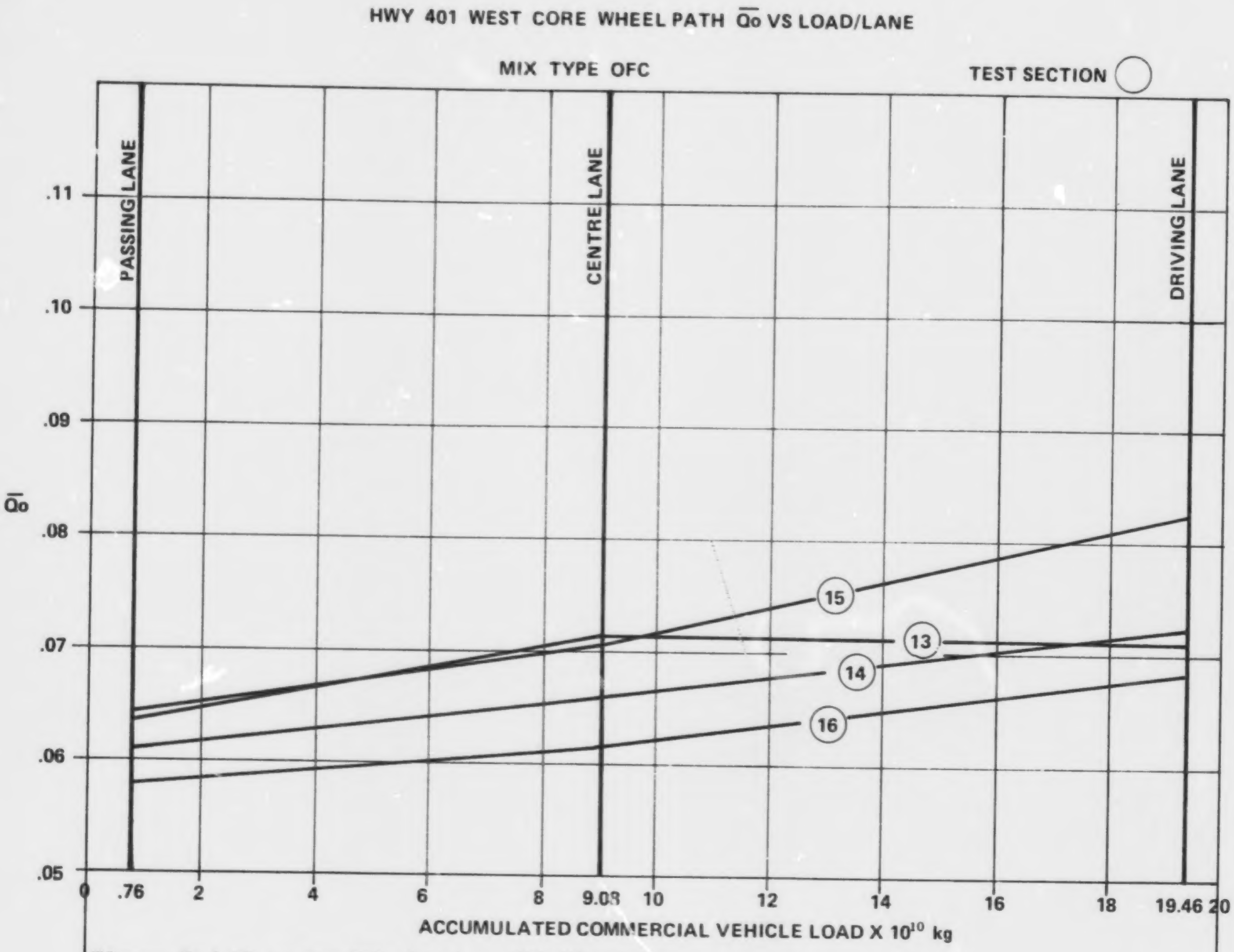


Figure 9c/ QO vs Traffic Load -- OFC Mixed Type

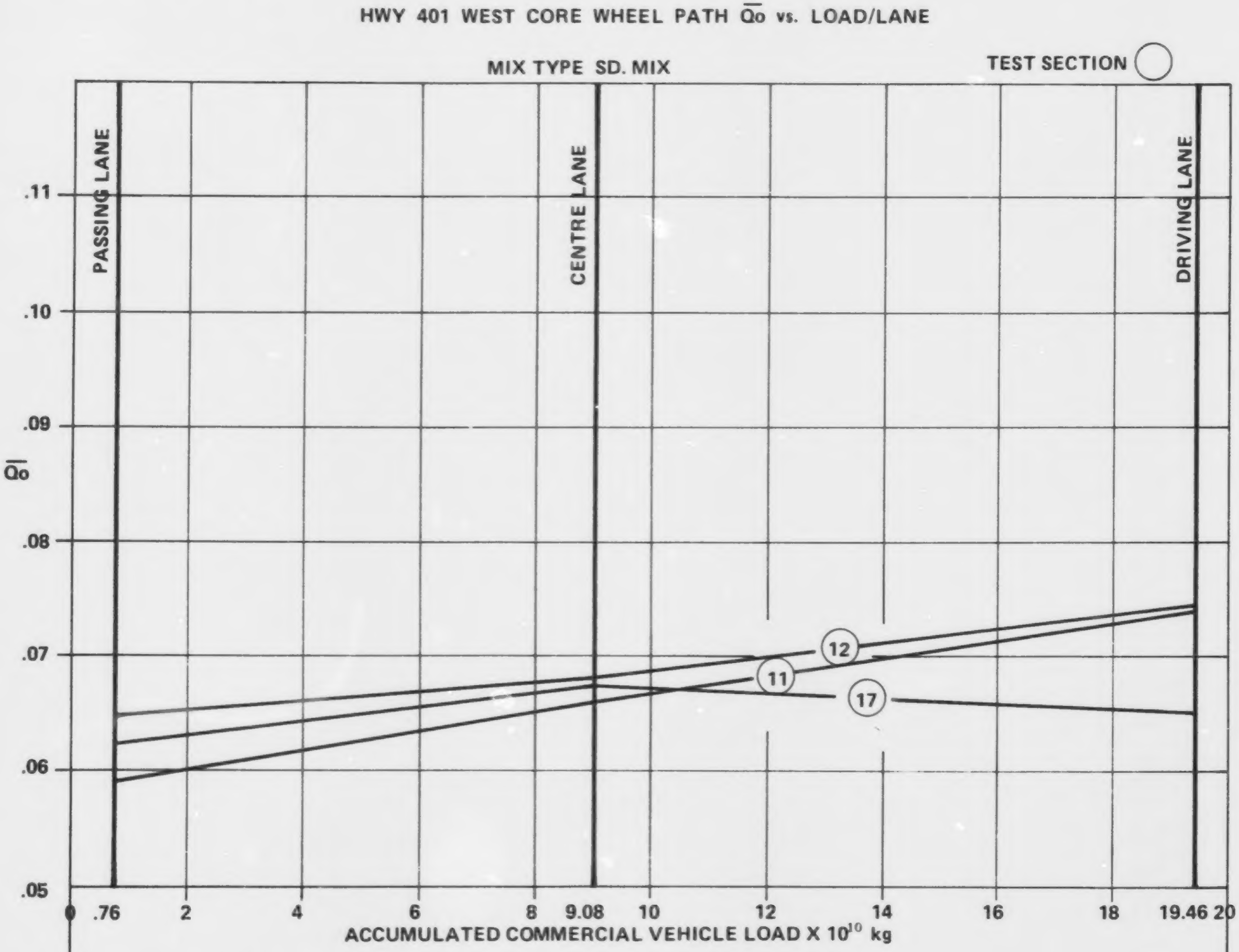


Figure 9d/ QO vs Traffic Load -- Sand Mix

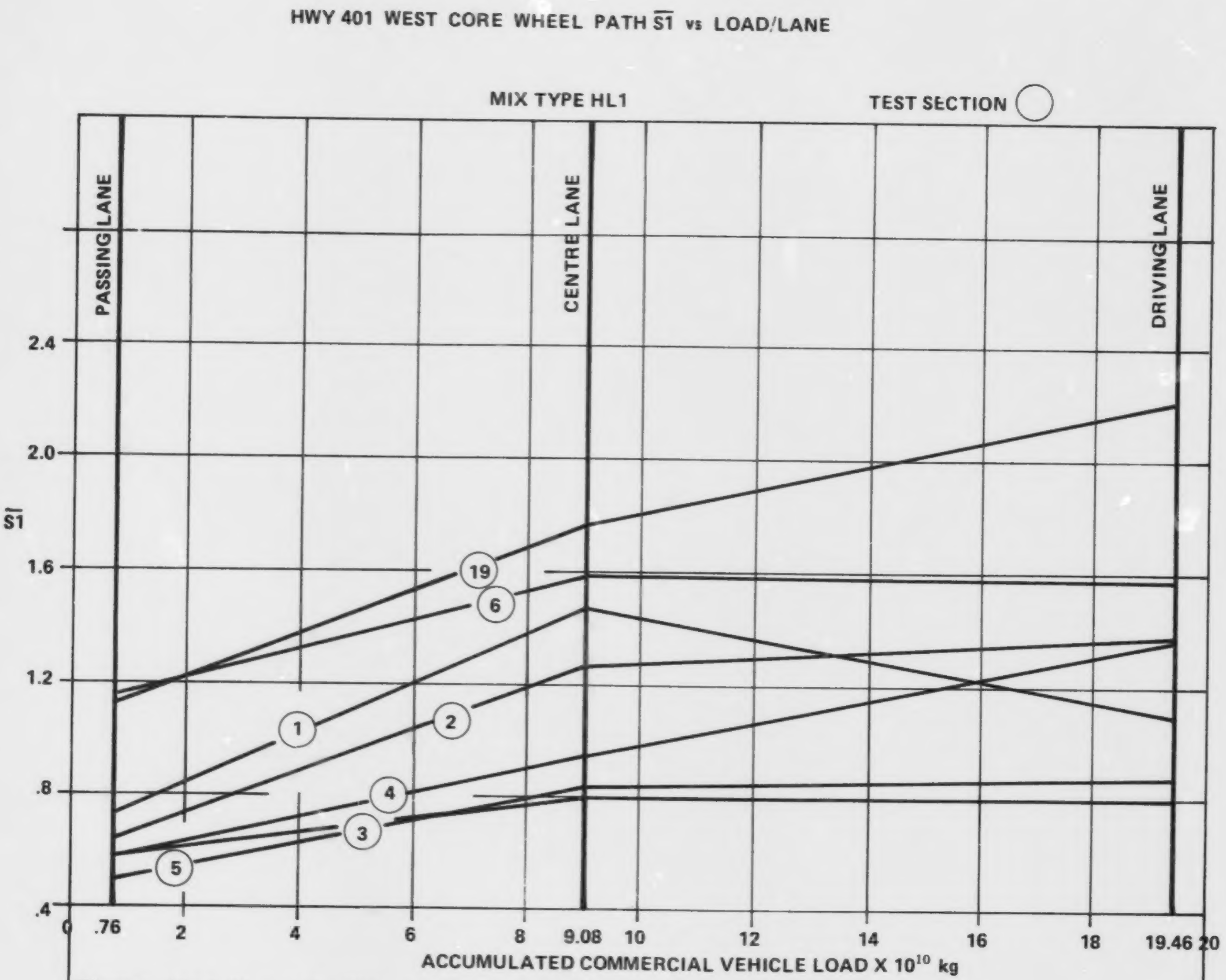


Figure 10a/ S1 vs Traffic Load -- HL-1 Mixed Type

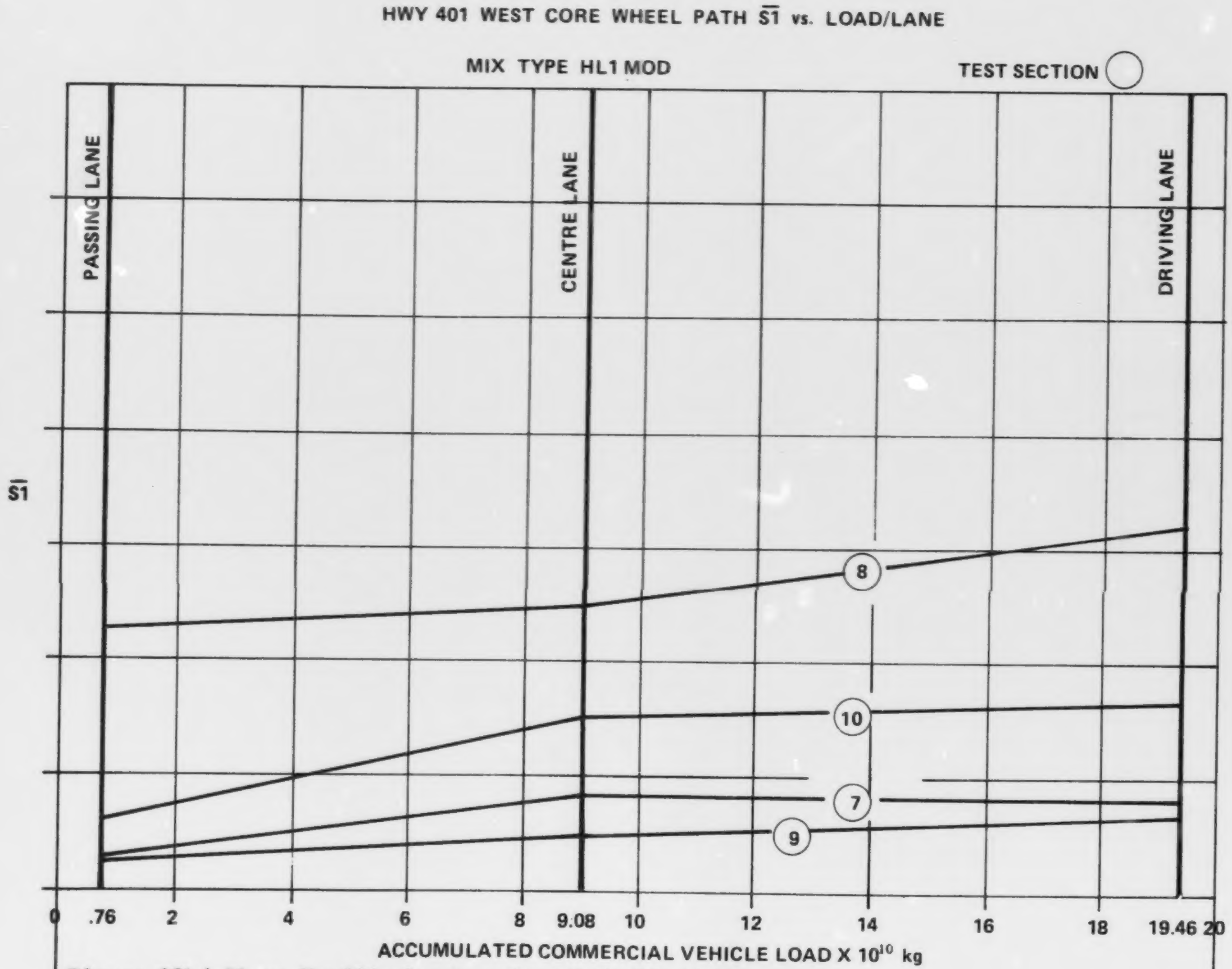


Figure 10b/ S1 vs Traffic Load -- HL-1 Mod. Mixed Type

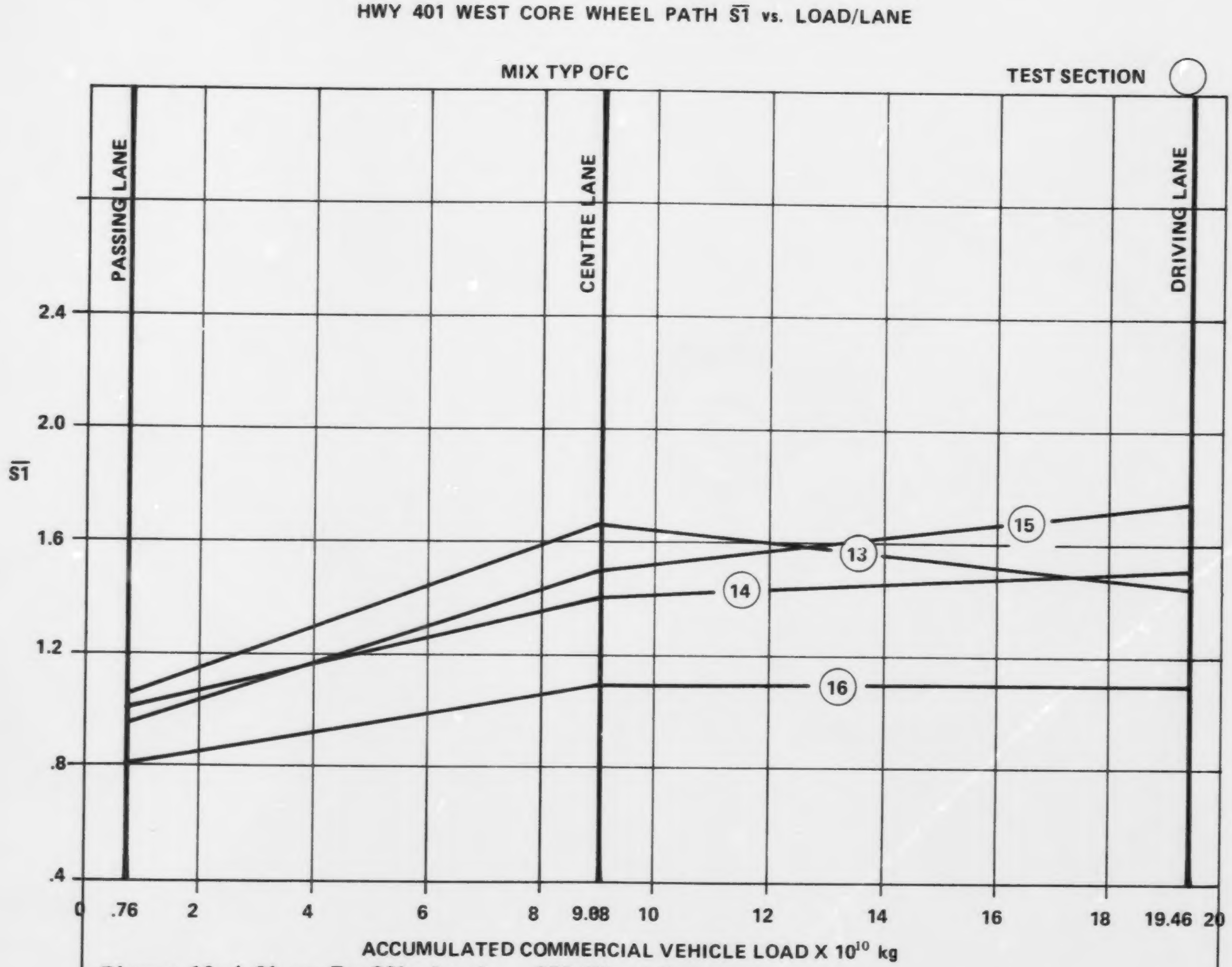


Figure 10c/ S1 vs Traffic Load -- OFC Mixed Type

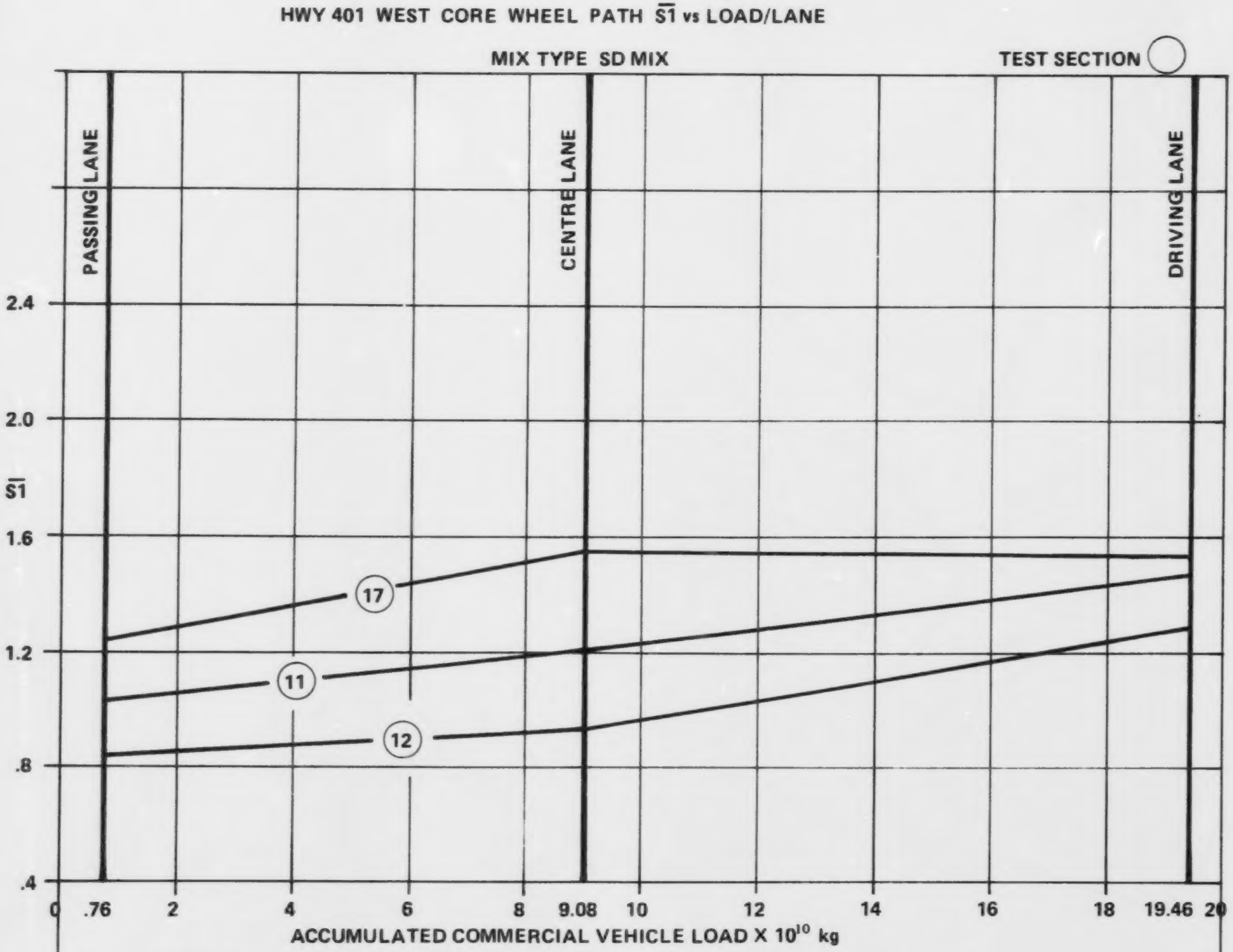


Figure 10d/ S1 vs Traffic Load -- Sand Mix

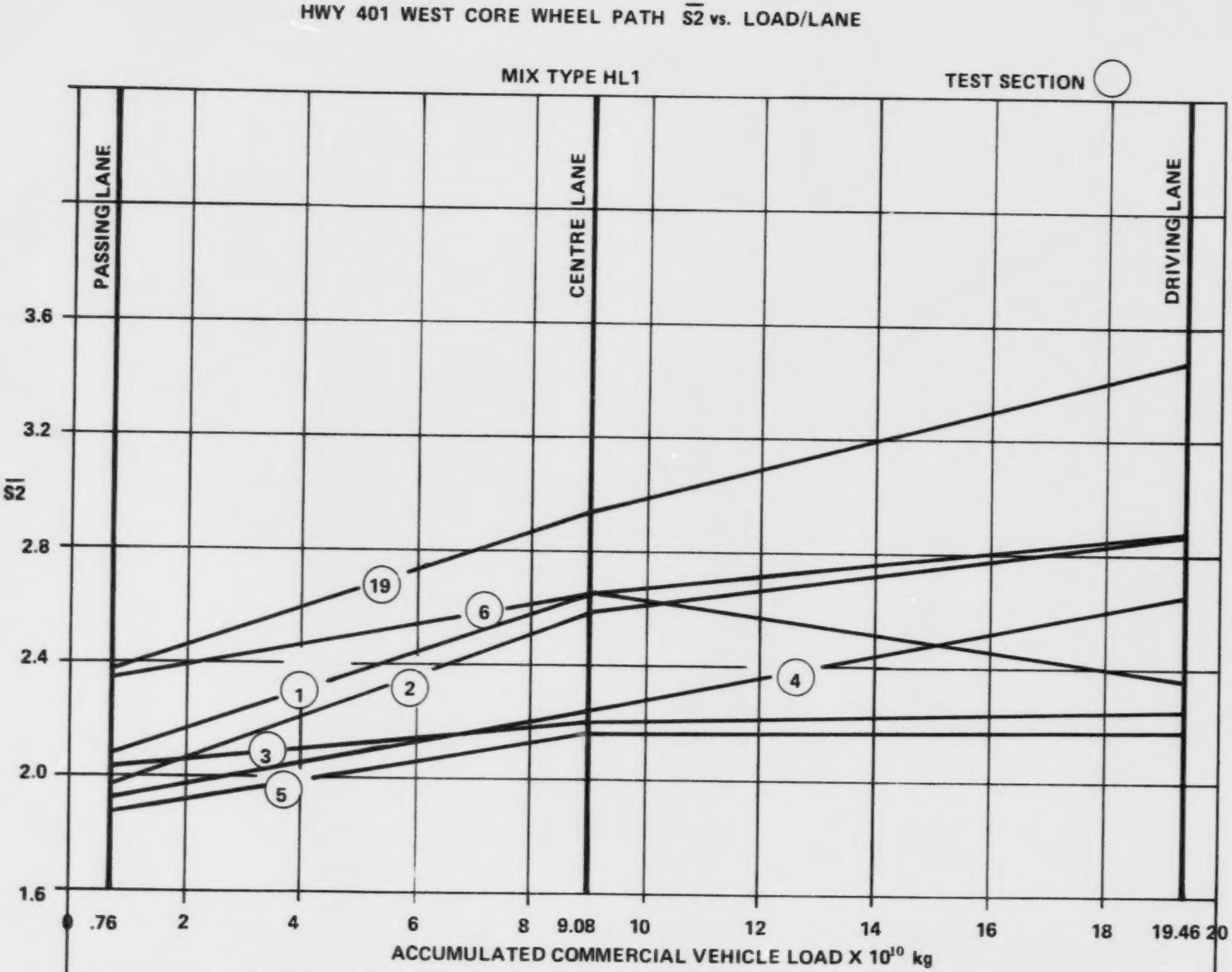


Figure 11a/ S2 vs Traffic Load -- HL-1 Mixed Type

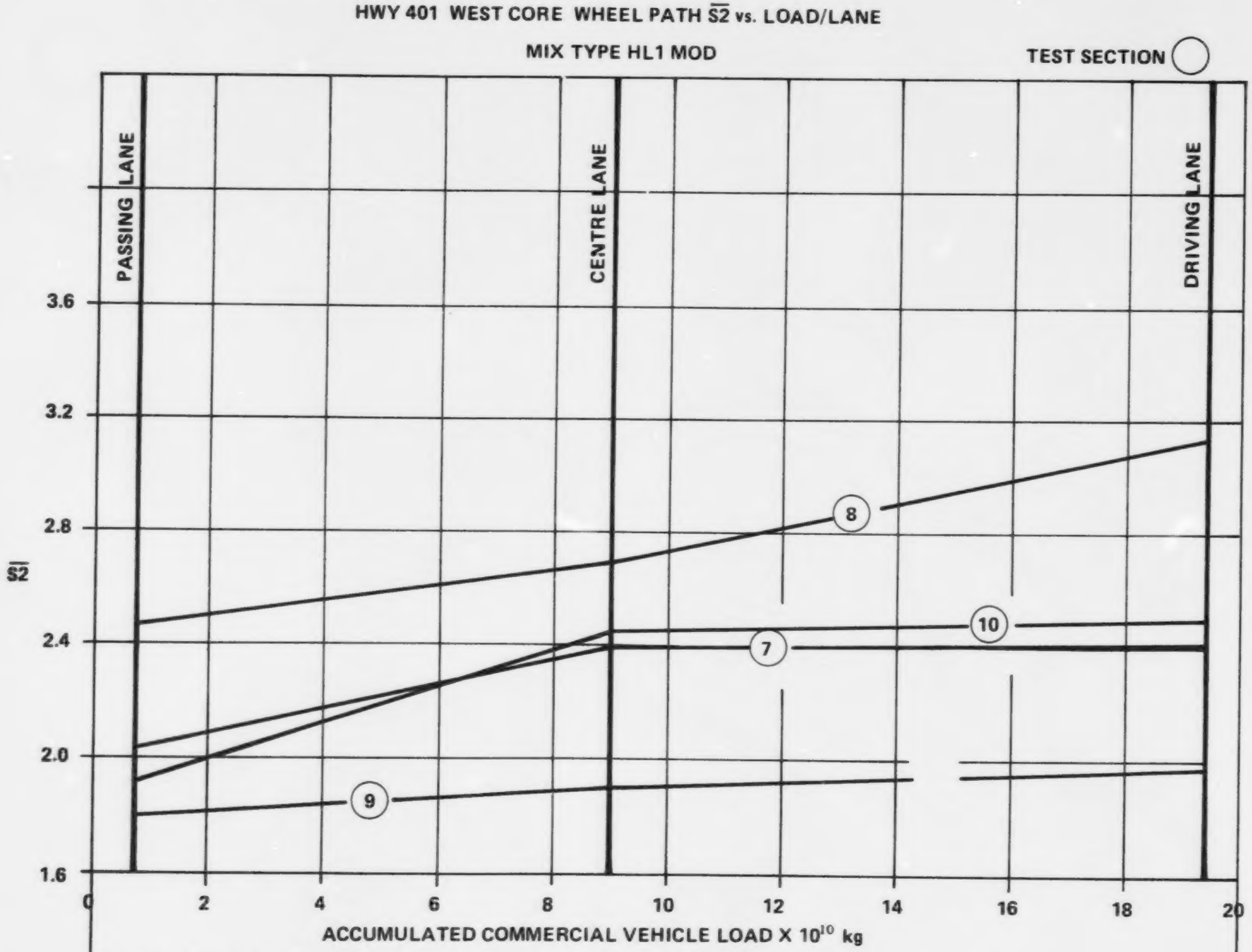


Figure 11b/ S2 vs Traffic Load -- HL-1 Mod. Mixed Type

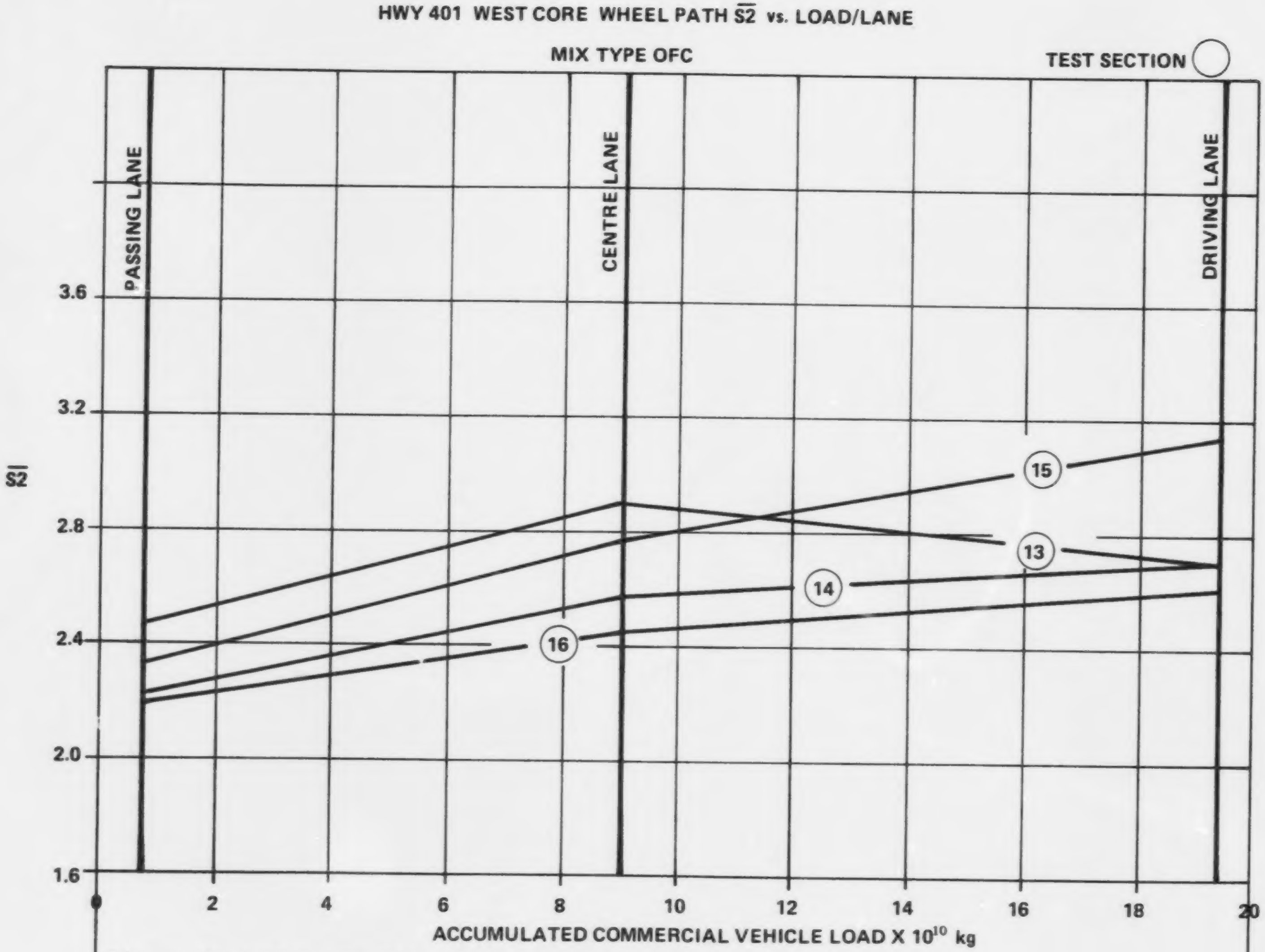


Figure 11c/ S2 vs Traffic Load -- OFC Mixed Type

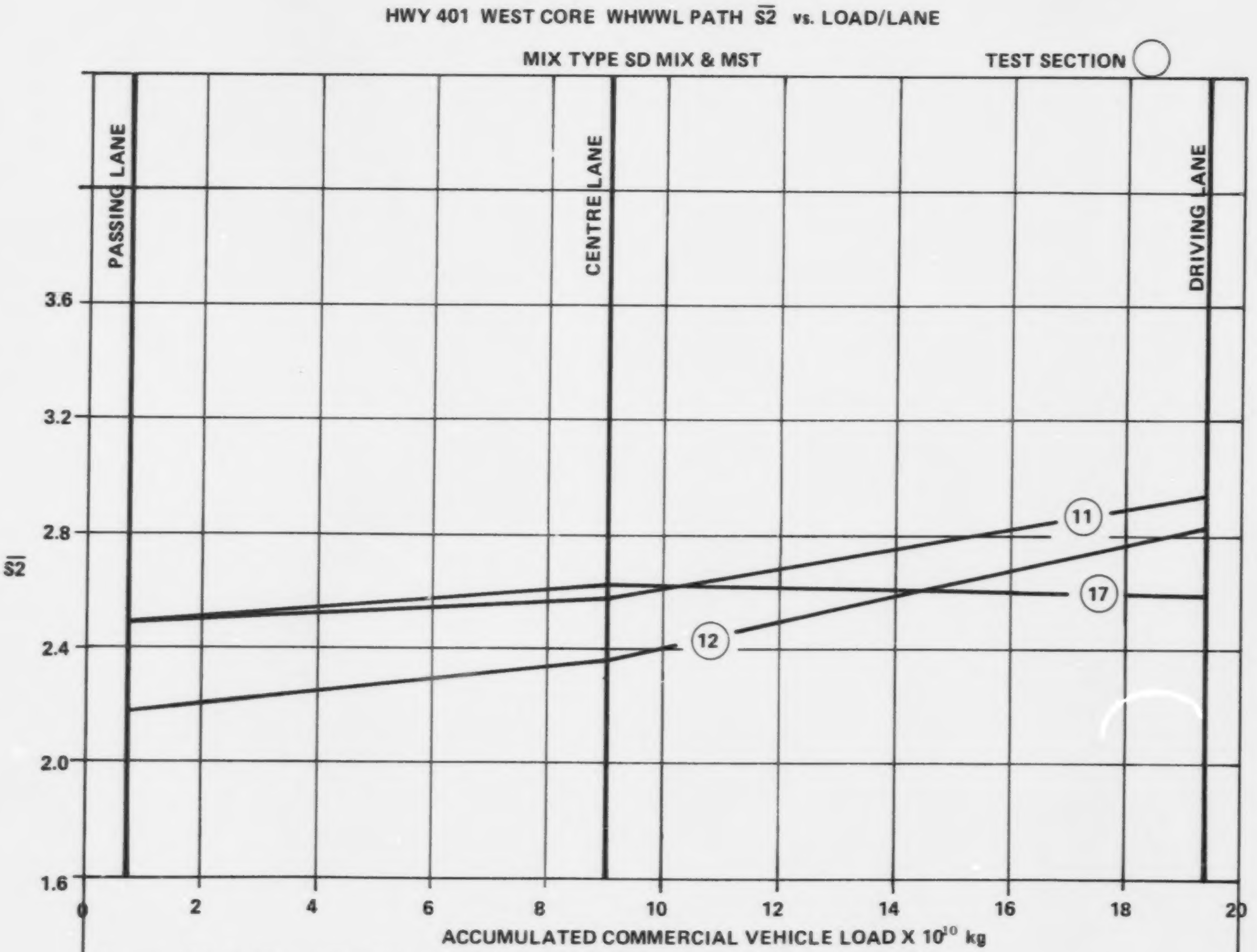
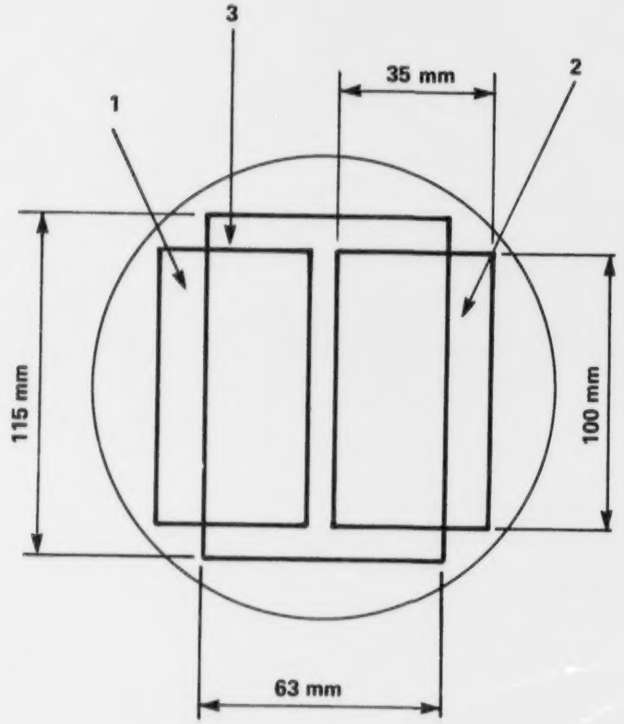


Figure 11d/ S2 vs Traffic Load -- Sand Mix



1 - 2 small area size (35 cm^2)

3 - large area size (72.45 cm^2)

Figure 12/ Target Area -- Diagram. Fields of View of the Instrument on Pavement Sample

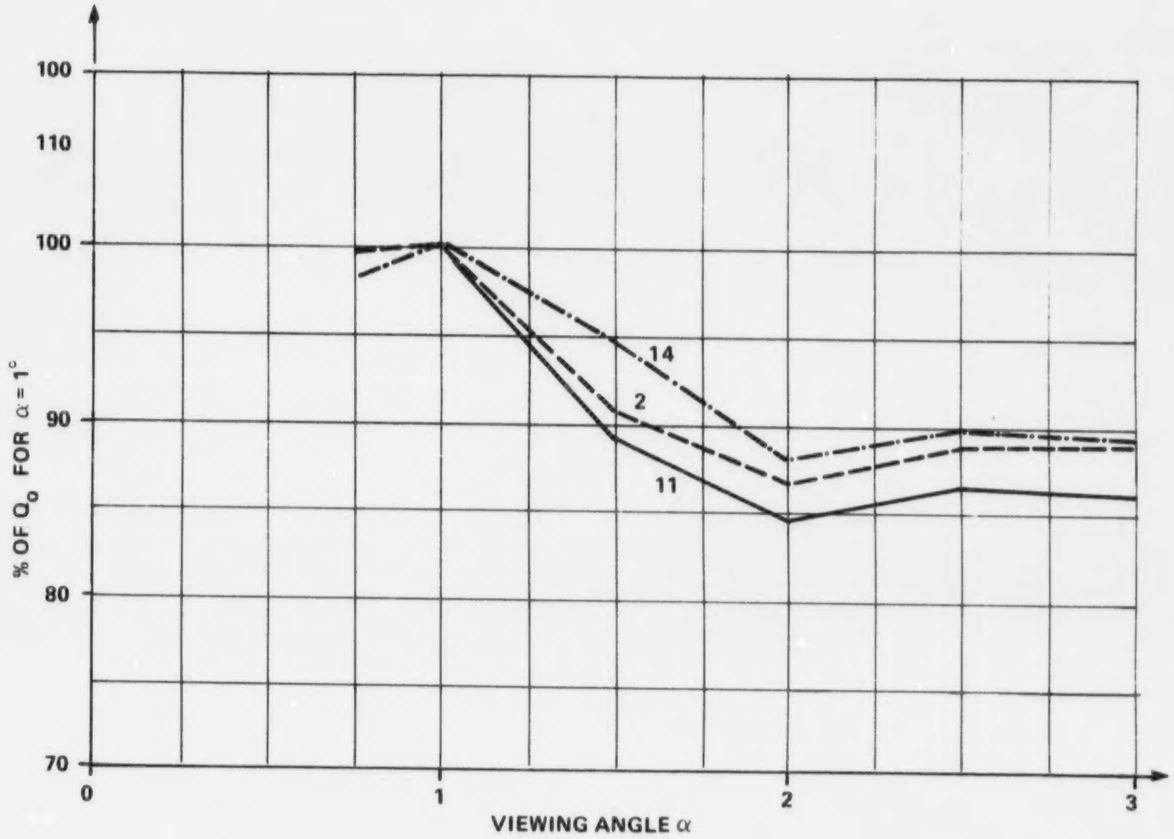


Figure 13/ Percentage Change of Brightness, QO with Viewing Angel α

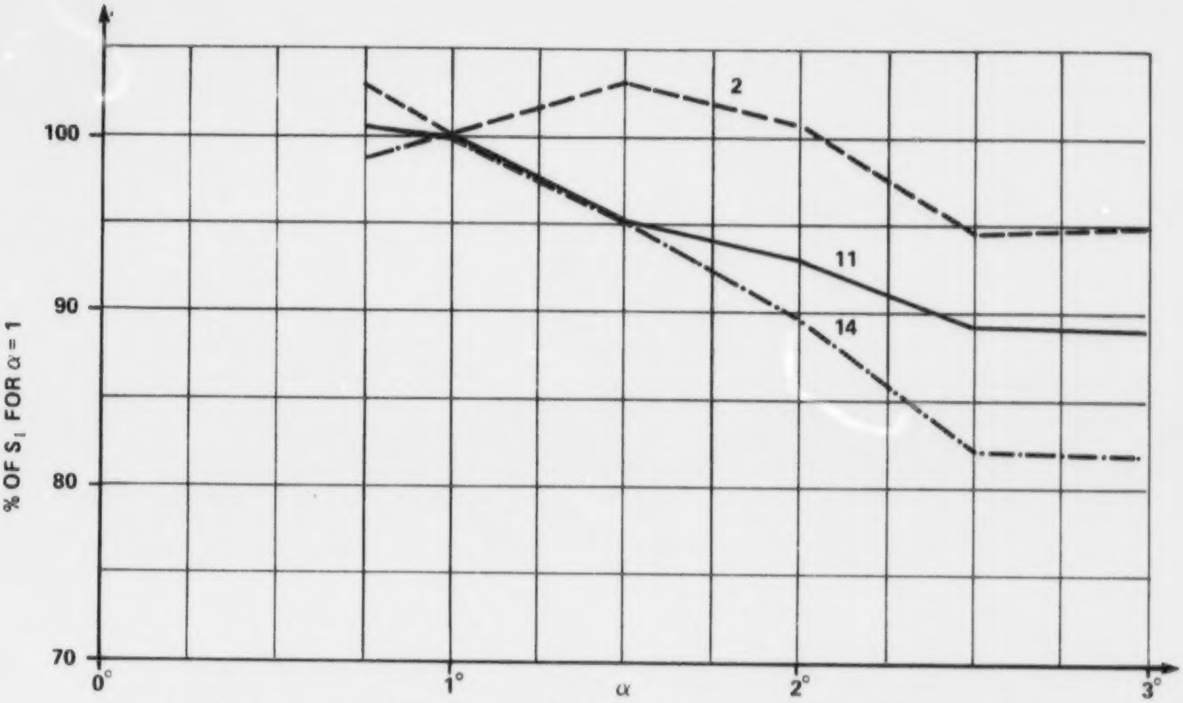


Figure 14/ Percentage Change of Specularity, S1 with Viewing Angle α

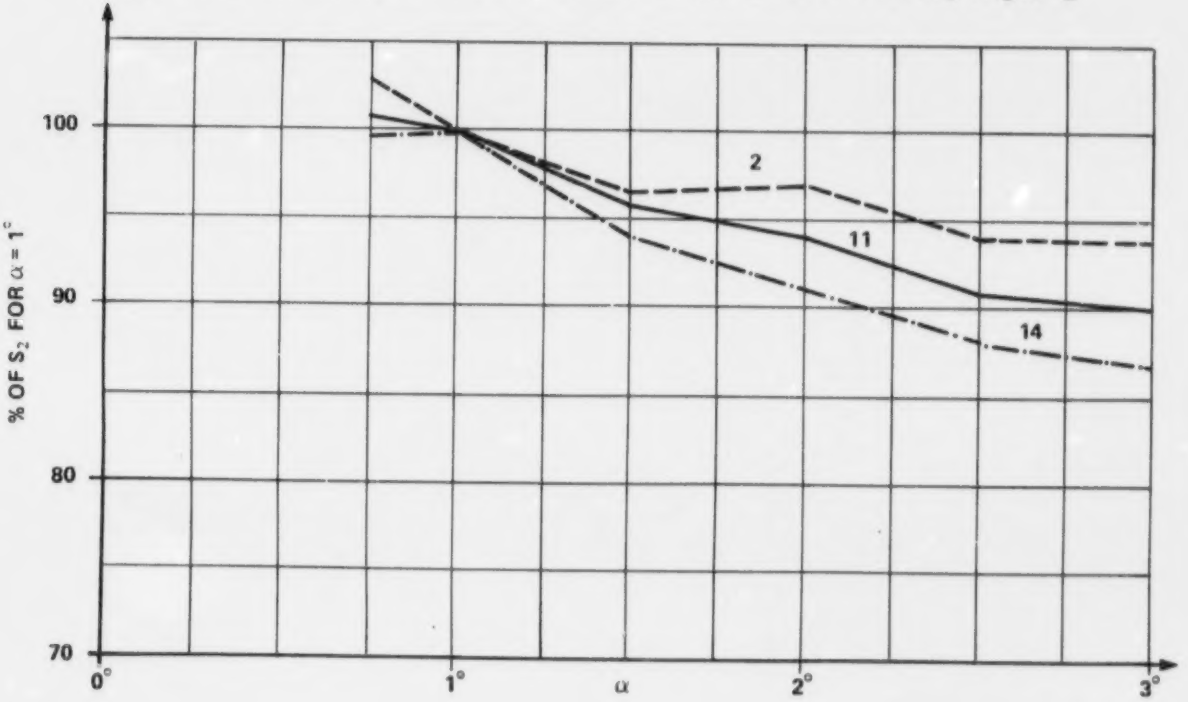


Figure 15/ Percentage Change of Specularity, S2 versus Viewing Angle α

APPENDIX A/

Ontario Test Sections

As part of the overall program dealing with the improvements of pavement surface texture and friction characteristics, two experimental projects were undertaken by MTC to test alternative bituminous surface course mixes.

To assess the effects of high volume traffic on the test surface mixes, in 1974 17 bituminous test sections were constructed along the westbound core portion of Highway 401 between Allen Expressway and Jane St. [13, 15]. Also, to assess the effects of low volume traffic, in 1978 an additional 17 test sections were constructed along a section of Highway 7 west of Lindsay [14].

The selection of materials and mix proportions of each of the experimental test sections was based on the Ministry's experience with the needs of Freeways and Secondary Highways.

The mix composition and characteristics are shown in Tables 3 and 4(a and b).

Preliminary Sampling Study

Since the utilization of six-inch core samples was never attempted before for the measurements of reflective matrices, it was necessary to ascertain an approximate size of the sample which would represent a typical pavement surface, as it occurs along a wheel path of a lane at a particular time. Consequently in order to establish a preliminary sample size, 20 core samples, of six-inch diameter were taken from a 50 foot section of Downsview Ave. which is an HL-1 (trap-rock) pavement with uniform surface texture and colour.

Ten cores were extracted from the right hand wheel path of the westbound lane and ten cores were extracted from between the wheel path portion. The spacing of samples was approximately five feet between the cores.

Based on the reflectively parameters (Q0, S1 and S2) obtained from the Downsview Ave. samples, the preliminary statistical analysis revealed that the largest fluctuations occur with the specularity parameter S1. In order to maintain the S1 variation of not more than ±10%, 95% of the time, a sample size of three cores must be measured from each specific location (i.e., wheel path) of an individual pavement type.

The sample mean variations (level of significance 95%) as compared with sample size is shown in Table A1.

Table A1/ Percent Variation of Means by Sample Size

	Number of Cores per Sample						
Reflectively Parameters	1	2	3	4	5	6	7
Q0	±18.7%	±13.3%	±10.8%	±9.4%	±8.4%	±7.7%	±7.1%
S1	±19.9%	±14.1%	±11.5%	±10.0%	±8.9%	±8.1%	±7.5%
S2	±8.6%	±6.1%	±5.0%	±4.3%	±3.9%	±3.5%	±3.3%

Using the same data from this particular pavement, it was also possible to determine, for a sample size of three cores or fields of view, the 95% confidence limits for strictly local and over-all variations. The results can be listed as follows:

Table A2/

	Local Samplings	Stretched-out Sampling
Q1	±3%	±11%
S2	±4.5%	±11.5%
S2	±3.5%	±5%

The values for S1 and S2 were transformed into differences of Log S1 and log S2 and plotted as eliptical loops into the Erbay Atlas diagram, refer to Figure A1 for local variations and to Figure A2 for over-all variation. The localized 95% confidence limits correspond very well to the density of points in the Erbay Atlas, whereas the stretched-out sampling reveals 95% confidence limits which are much larger. This means the accuracy of the instrumentation system is adequate for the purpose of classification.

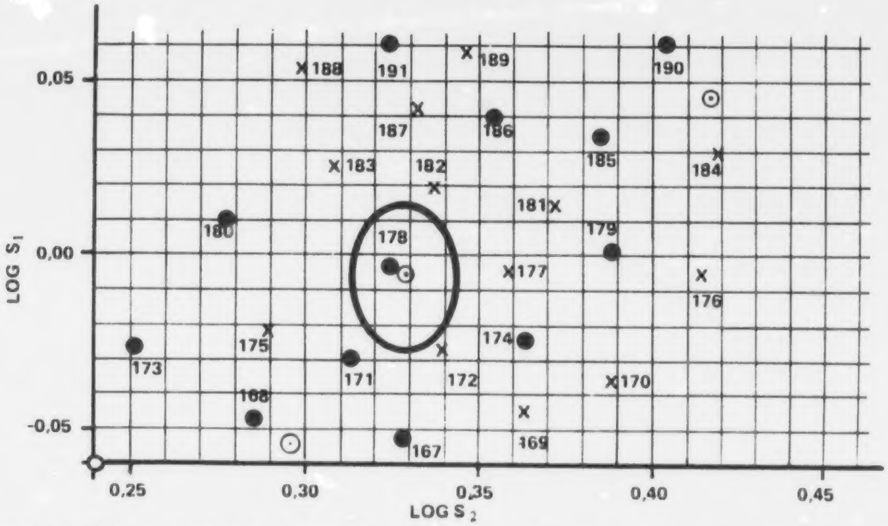


Figure A1/ 95% Confidence Limits of Parameters S1 and S2 for Local Variation (3 Samples)

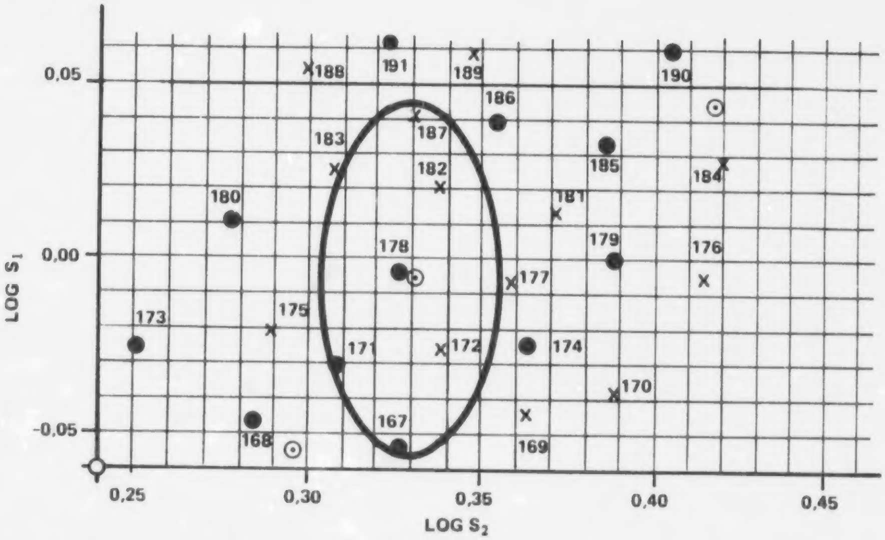


Figure A2/ 95% Confidence Limits of Parameters S1 and S2 for Over-all Variation (3 Samples)

Based on the Downsview Ave. core samples analysis the following sampling pattern was used for the extraction of core samples form the experimental test sections on HIghway 7 and Highway 401.

Highway #7 Core Sampling

Twenty-two core samples were extracted from Section 15 and 17 and 28 eight cores were extracted from section 11 as shown by sampling pattern diagrams in Figures A3 and A4.

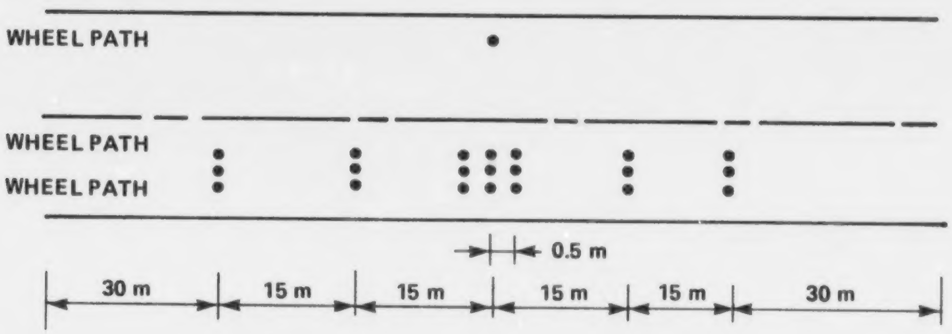


Figure A3/ Sampling Pattern for Section 15 & 17

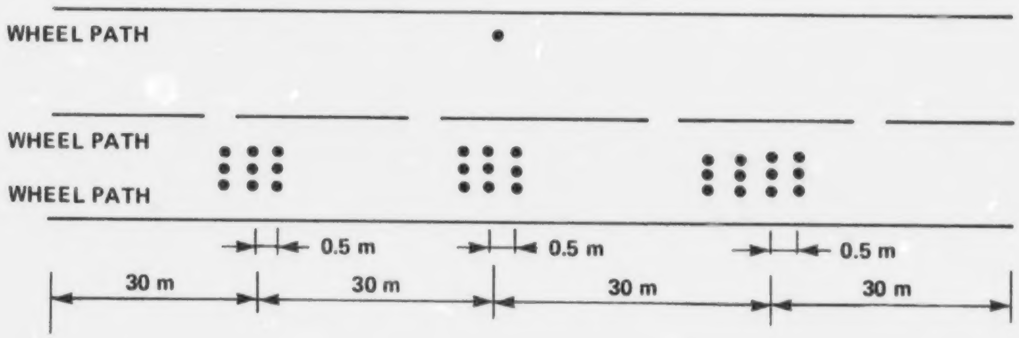


Figure A4/ Sampling Pattern for Section 11

From the remaining 14 sections (i.e., 1-10, 12-14 and 16) four core samples were extracted from the R.H. wheel path portion only. Three core samples were taken from the EBL at the spacing of 30 m between the cores and from each end of the section and one core was taken from the mid-section of the WBL. The total member of core mounted to 128.

Highway #401 Core Sampling

The Highway 401 test section (18 total) were constructed along the west-bound core section of the westbound lanes (3 lanes wide).

Each test section is 448' long and 37' wide. Six core samples were extracted from each lane of each section for the total of 18 core samples per section as shown in Figure A5.

Immediately west of the test site, Highway 401 was resurfaced early in 1983 with an open grade mix surface course bituminuous pavement. In order to have the reflectively characteristics of a newly placed roadway surface as a measure of comparison, it was also decided to extract core samples from the 448' section of this newly-placed bituminuous surface. Thus from the Highway 401 test section, 18 core samples were extracted from 19 different test sections for the total of 342 core samples.

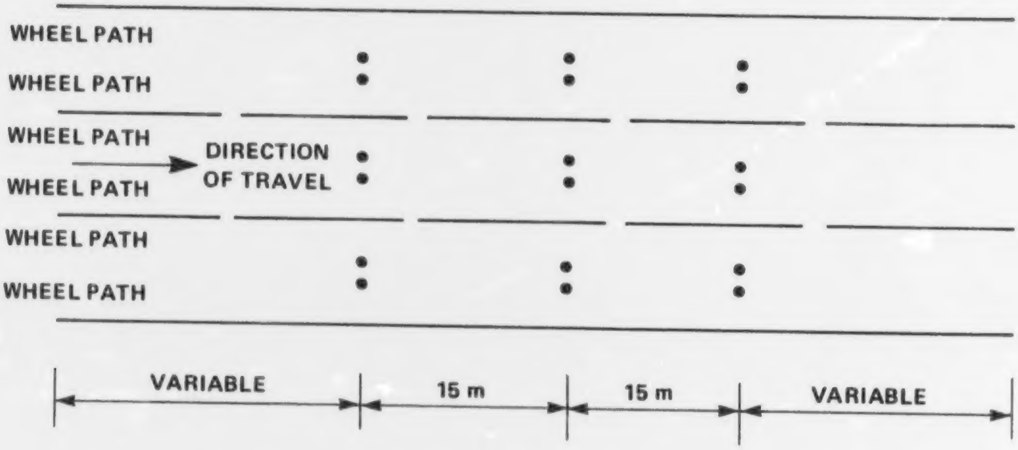


Figure A5/ Highway 401 Sampling Pattern

Traffic Data

Traffic data for the assessment of Highway 7 test section cores was obtained from 24 hour counts taken during the summer month and factored to obtain AADT volumes and percentage of commercial vehicles. The 1983 traffic counts exhibited slight decline from the 1978 counts, consequently, for the purpose of analysis, it was decided to accept 1978 AADT counts for both time periods.

The visual assessment of Highway 7 test sections indicated that after five years of service the pavement was in a reasonably good condition. With the exception of minor cracks and minor coarse aggregate loss there was no other pavement distress manifestation.

The traffic data for the assessment of Highway 401 cores was obtained from the permanent counting stations located immediately east of the test site. Highway 401 traffic has steadily grown from the time the test section were constructed (1974) to the present time when the core samples were taken 1983). The summarized traffic history is shown for both Highway 401 and Highway 7 test sections in Table A6.

The visual assessment of Highway 401 test sections and the core samples revealed that the condition of these test sections were in worst state of deterioration than those of Highway 7.

Generally there was significant flushing, loss of coarse aggregate which predominantly occured along the passing lane, multiple transfer cracks at the expansion joints and multitude of random cracks. Generally the conditions of the driving and centre lanes were better than that of the passing lane. This seems to be rather odd, since one would expect the lanes with heaviest vehicle loads and highest traffic to undergo greatest deteriorations. There are couple of conclusions that seem to be logical to rationalize this behaviour. At the present time Highway 401 has somewhat a better sub-base than normally provided for a freeway. In addition to the regular granular base along the test section, this highway has also 9" of reinforce concrete which helps to reduce the flexing of the surface layer under the heavy loads. In addition, the heavy load have compacted the top layers to greater extent reducing the deterioration due to weathering which was acting on the passing lane.

Table A6/ AADT Traffic Volumes

			AADT			
Location	Year	Vehicle Class	Driving Lane	Centre Lane	Passing Lane	Age Yrs.
Hwy. 401	1975	Total	12 900	17 300	14 600	8
		Commercial	3 740	1 900	150	
Hwy. 401	1983	Total	13 000	19 700	16 700	
		Commercial	3 770	2 160	170	
Hwy. 7	1978	Total	5 525			5
		Commercial	663			

APPENDIX B/

Pavement Reflectance Characteristics Study

PAVEMENT SAMPLING PROCEDURE proposed to RTAC, for Provinces in Canada

General Instructions

1/ A knowledgeable person should select samples so that they are representative of the pavement surface to be studied. Samples from unusually contaminated pavement locations or from surfaces in poor condition (e.g., oil spills; cracked, bleeding, or rutted surfaces etc.) should be avoided.

2/ Samples cut using a 6 inch (152 mm) core drill are preferred, however samples using an 8 inch (203 mm) core drill would also be acceptable.

3/ It is sufficient to have measurements from three samples to establish an r table, however because of variations between wheel path and non-wheel path areas it is recommended that three samples be taken from each of these areas.

4/ It is suggested that if possible road surfaces of concrete and two types of asphalt be sampled.

Suggested Field Procedure

Select a test section as follows:

1/ Choose a lane which is most representative of the general pavement condition.

2/ Three samples should be selected from a wheel path and three from between the wheel paths.

3/ Before removal, the samples should be marked temporarily with tape to indicate the direction of traffic flow.

4/ After the core has been removed it should be saw-cut to a thickness of 45 ± mm.

5/ The temporary tape marking should be removed and replaced by a permanent direction of traffic flow identification (e.g., oil crayon or paint) on the underside of the cut sample.

6/ The sample should be hosed down with water at cutting time if possible. If site cleaning is not practical, it should be washed later in water and brushed with a soft brush.

7/ As much of the data that is available should be entered on the accompanying form so that a record of the characteristics of the test section will be available for later analysis.

8/ The samples should be packed as fragile material in such a manner that they are fully supported over their entire area so they will not deform in transit. If the samples are to be returned to the sender, the method used should be designed so that they may be easily repacked in the same container when the measurements are completed.

9/ Each set of samples should be accompanied by a data sheet with as much information filled out as possible. The data on reflectance measurements will be provided after the U. of T. measurements, and a copy of the sheet will be sent back to the agency providing the sample.

Province ______ County ______ Roadway No ______
Location ______ Type of Traffic ______ AADT ______
Pavement Age ______ TD ______ Date ______

Mix Composition

Coarse Aggregate-% ______ Description ______ Source ______
Fine Aggregate-% ______ Description ______ Source ______
Cement (Asp/Port) -% ______ Description ______ Source ______

Mix Characteristics: Mix Type ______ MSA ______
Marshall: Stab-kN ______ Flow-mm (*0.25) ______ AV-% ______ VMA-% ______
Compressive Strength-MPa ______ Water/Cement Ratio ______
Lab Data Included (Y/N) ______ Field Data Included (Y/N) ______
Coarse Aggregate: MSA ______ PSV ______ AAV ______ LA ______

SAMPLE			PAVEMENT HISTORY				SKID RESISTANCE					
ID	LOCATION		LANE	AGE	AADT	TRK	50 km/h		100 km/h		km/h	
	WP	BWP					Date	Sn	Date	Sn	Date	Sn

REFLECTANCE				
QO	S1	S2	CIE	ERBAY

LEGEND

ADDT:	Average Annual Daily Traffic
TD:	Texture Depth
Asp/Port:	Asphalt/Portland
MSA:	Maximum Size Aggregate
Stab:	Stability
AV:	Air Voids
PSV:	Polished Stone Value
AAV:	Aggregate Abrasion Value
LA:	Los Angeles Test
ID:	Sample Identification
WP:	Wheel Path
BWP:	Between Wheel Path
TRK:	Truck
Sn:	Skid Number

APPENDIX C

Summary of data by section. In the appendix the estimated average for each section are presented together with standard deviation.

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 1 LOCATION STA 146 + 50 to 150 + 65

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Igneous	Maple Ridge Stone
1. F. AGG	35	Igneous	Maple Ridge Washed Screenings
2. F. AGG.			
MIN FILLER			
% ASP	5.3	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	6.049	
MARSHALL FLOW	13.6	
V.M.A. % VOL.	17.7	
VOIDS % VOL.	6.5	

C. AGG. PROPERTIES

PSV = 4.6
AAV = 2.2
LA. = 16.0
PN. = 10.4

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.0750(n=3) BWP -	.0031	4.113	0.6184	0.0920	14.877	1.8994	0.0838	4.415
LN West WP 0.0726(n=1) BWP --	--	--	0.7940	--	--	2.0846	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.4	44.3	0.978	2.206	31.4	42.9	1.715	3.997				
39.8	41.8	1.343	3.210	39.6	39.5	1.711	4.331				
48.9	39.4	1.514	3.847	50.5	37.7	1.365	3.624				
60.6	37.6	0.750	1.994	59.4	37.1	0.862	2.322				
70.7	34.7	0.643	1.851	69.9	35.2	1.852	5.261				
80.0	33.8	2.048	6.051	79.9	36.4	2.740	7.529				
89.0	35.2	1.202	3.410	90.7	34.2	1.277	3.733				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.1			60	96.2						
70	98.0			70	98.0						
80	99.8			80	99.5						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.185 V + 49.065	-0.926
West*	SN = -0.130 V + 45.431	-0.834

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 2 LOCATION STA 150 + 65 to 154 + 80

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Limestone	Beamish Brown Stone
1. F. AGG	35	Igneous	Washed Maple Ridge Screenings
2. F. AGG.	-		
MIN FILLER	-		
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	8.118	
MARSHALL FLOW	12.3	
V.M.A. % VOL.	14.8	
VOIDS % VOL.	5.7	

C. AGG. PROPERTIES

PSV = 4.3
AAV = N.T.
LA. = 26.0
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.10031(n=3) BWP -	0.00829	8.265	0.82070	0.10938	13.328	1.99987	0.11352	5.676
LN West WP 0.10673(n=1) BWP --	--	--	1.06330	--	--	2.06890	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
32.3	34.9	1.176	3.371	32.1	36.5	1.100	3.010				
40.3	35.1	0.919	2.615	38.0	33.5	0.918	2.738				
51.6	31.7	0.404	1.274	51.3	30.8	0.916	2.976				
60.9	31.3	1.637	5.230	60.4	30.6	0.702	2.298				
71.7	29.3	1.216	4.152	70.2	29.8	1.274	4.280				
82.9	28.4	2.728	9.598	79.7	30.9	1.847	5.985				
93.2	29.0	1.061	3.651	91.5	29.5	1.041	3.524				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.3			60	96.5						
70	98.3			70	98.5						
80	100.0			80	99.9						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.119 V + 38.616	-0.845
West*	SN = -0.101 V + 37.837	-0.784

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 3 LOCATION STA 154 + 80 to 158 + 95

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Limestone	Blend of Beamish (Brown) and Maple Ridge Stone
1. F. AGG	35	Igneous	Washed Maple Ridge Screenings
2. F. AGG.			
MIN FILLER			
% ASP	5.3	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	6.539	
MARSHALL FLOW	18.8	
V.M.A. % VOL.	17.3	
VOIDS % VOL.	6.4	

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 21.0
PN. = 109

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0		σ Q0	CV Q0	‾ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN WP BWP	East 0.09092(n=3) -	0.00518	5.697	0.77147	0.08264	10.712	1.98483	0.01445	0.728
LN WP BWP	West 0.08222(n=1) --	--	--	0.80740	--	--	1.99550	--	--
LN WP BWP									

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.3	41.1	0.709	1.726	31.4	42.4	0.995	2.344				
40.3	39.7	0.424	1.069	39.2	38.7	0.741	1.914				
51.1	36.8	0.378	1.030	51.6	36.4	0.603	1.657				
60.1	36.0	0.451	1.251	60.7	35.9	1.242	3.457				
70.3	33.7	1.650	4.892	70.7	34.2	2.616	7.642				
81.0	31.5	1.923	6.106	80.0	35.3	3.109	8.809				
93.8	33.2	0.071	0.213	91.6	33.3	1.331	3.995				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.5			60	96.7						
70	98.3			70	98.4						
80	100.2			80	99.9						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.157\ V + 45.373$	-0.912
West*	$SN = -0.134\ V + 44.814$	-0.833

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 4 LOCATION STA 158 + 95 to 163 + 10

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Igneous/List	Blend of Beamish (Brown) and Maple Ridge Stone
1. F. AGG	35	Limestone	Washed Beamish (Brown) Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.4	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	8.229	
MARSHALL FLOW	13.5	
V.M.A. % VOL.	15.1	
VOIDS % VOL.	5.5	

C. AGG. PROPERTIES

PSV = 4.5
AAV = 2.2
LA. = 21.0
PN. = 109

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.09184(n=3) BWP -	0.00171	1.862	0.78903	0.06905	8.751	1.94860	0.05768	2.960
LN West WP 0.10331(n=1) BWP --	--	--	0.94830	--	--	2.17730	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.8	40.2	1.494	3.717	30.2	43.0	1.958	4.553				
39.6	38.6	1.697	4.397	38.7	39.1	0.579	1.481				
51.9	33.7	1.115	3.312	50.9	35.6	1.464	4.109				
60.0	34.9	1.305	3.743	60.5	35.6	1.531	4.296				
69.9	32.0	1.464	4.580	71.4	34.6	2.545	7.357				
79.2	30.9	1.953	6.327	80.8	35.2	2.822	8.024				
91.4	31.5	0.495	1.569	90.9	31.5	0.458	1.455				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.1			60	97.3						
70	98.2			70	99.2						
80	100.2			80	100.1						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.165\ V + 44.381$	-0.883
West*	$SN = -0.156\ V + 45.886$	-0.858

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 5 LOCATION STA 163 + 10 to 167 + 25

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Limestone	Beamish (Brown) Stone
1. F. AGG	35	Limestone	Washed Beasmish (Brown) Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.1	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.784	
MARSHALL FLOW	13.5	
V.M.A. % VOL.	13.7	
VOIDS % VOL.	5.5	

C. AGG. PROPERTIES

PSV = 4.3
AAV = N.T.
LA. = 26.0
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ QO	σ QO	CV QO	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN WP BWP	East 0.10526(n=3) -	0.00701	6.665	0.79857	0.15125	18.941	1.90750	0.10015	5.251
LN WP BWP	West 0.13425(n=1) --	--	--	1.03870	--	--	2.17030	--	--
LN WP BWP									

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.6	33.4	1.289	3.858	31.4	32.3	1.292	3.997				
39.2	33.7	0.000	0.000	40.8	32.0	1.106	3.458				
51.7	29.5	0.436	1.478	50.8	30.3	1.222	4.029				
59.9	30.3	1.002	3.302	60.1	30.1	1.976	6.556				
70.0	28.3	1.069	3.783	70.8	28.5	1.721	6.033				
80.5	25.9	1.484	5.736	79.5	32.4	4.196	12.963				
90.8	28.3	0.071	0.249	89.6	27.1	0.945	3.483				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.3			60	96.9						
70	98.2			70	98.5						
80	100.1			80	99.7						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.123 V + 37.101	-0.857
West*	SN = -0.063 V + 34.217	-0.505

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 6 LOCATION STA 167 + 25 to 171 + 40

TEST SECT DESCRIPTION

MIX TYPE O.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	65	Igneous	Maple Ridge Stone
1. F. AGG	35	Limestone	Washed Beamish (Brown) Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.250	
MARSHALL FLOW	12.5	
V.M.A. % VOL.	16.3	
VOIDS % VOL.	6.5	

C. AGG. PROPERTIES

PSV = 46
AAV = 2.2.
LA. = 16
PN. = 104

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ QO	σ QO	CV QO	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.08224(n=3) BWP -	0.00484	5.881	0.63120	0.15313	24.261	1.82900	0.09310	5.090
LN West WP 0.08200 BWP --	--	--	0.47100	--	--	1.76070	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION PAGE 2

SKID MEASUREMENTS **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.8	44.6	1.735	3.892	30.8	44.0	1.360	3.092				
40.0	42.3	0.777	1.837	38.9	40.2	0.506	1.257				
50.9	38.9	0.472	1.214	50.5	40.2	0.929	2.309				
61.0	38.3	0.529	1.382	60.8	38.6	0.838	2.175				
70.6	35.6	1.258	3.531	70.3	36.2	2.506	6.923				
81.7	35.0	2.764	7.893	79.6	34.0	8.118	23.878				
90.8	36.0	0.353	0.981	90.1	35.7	0.416	1.164				

NOISE LEVEL MEASUREMENT **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.1			60	96.6						
70	98.2			70	98.4						
80	99.8			80	99.6						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.165\ V + 48.672$	-0.888
West*	$SN = -0.146\ V + 47.204$	-0.721

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 7 LOCATION STA 171 + 40 to 175 + 55

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Limestone	Beamish (Brown) $1/_2$" stone
1. F. AGG	45	Sand	Ormell sand
2. F. AGG.			
MIN FILLER			
% ASP	4.8	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	8.585	
MARSHALL FLOW	11.8	
V.M.A. % VOL.	13.2	
VOIDS % VOL.	2.5	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN WP BWP	East 0.11584(n=3) -	0.00810	6.993	1.01433	0.14555	14.350	2.12257	0.07690	3.623
LN WP BWP	West 0.10644(n=1) --	--	--	0.87860	--	--	2.03100	--	--
LN WP BWP									

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.5	30.3	1.936	6.385	31.1	31.0	1.408	4.538				
39.7	30.0	0.071	0.235	39.1	28.7	0.619	2.154				
50.7	26.9	0.964	3.585	52.4	28.0	0.378	1.354				
60.7	27.5	0.200	0.727	60.8	28.2	0.556	1.974				
72.2	25.0	1.101	4.400	71.4	25.7	2.554	9.951				
83.1	24.4	3.112	12.766	80.9	27.3	2.234	8.183				
92.2	24.4	0.636	2.603	92.6	24.4	0.971	3.986				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.0			60	97.0						
70	98.8			70	98.9						
80	100.5			80	100.1						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.108 V + 33.530	-0.811
West*	SN = -0.089 V + 33.045	-0.790

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 8 LOCATION STA 175 + 55 to 179 + 70

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Limestone	Beamish (Brown) $1/_2$" stone
1. F. AGG	45	Sand & L. Stone	Ormell sand and Beamish unwashed Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	9.919	
MARSHALL FLOW	15.8	
V.M.A. % VOL.	11.7	
VOIDS % VOL.	1.7	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ QO	σ QO	CV QO	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.11204(n=3) BWP -	0.00116	1.040	0.89967	0.34678	38.545	2.07597	0.25356	12.214
LN West WP 0.12226(n=1) BWP --	--	--	0.86060	--	--	1.92200	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.3	33.0	1.031	3.121	31.8	31.5	0.862	2.738				
40.7	31.1	0.071	0.227	39.0	29.0	0.559	1.930				
49.5	30.2	1.361	4.513	51.8	28.3	0.757	2.672				
60.0	29.2	1.900	6.507	61.1	27.9	0.757	2.771				
71.6	26.3	1.644	6.244	70.9	26.7	2.386	8.925				
80.1	25.3	1.472	5.818	81.0	28.6	1.950	6.811				
92.2	24.8	0.353	1.423	93.8	25.2	1.002	3.980				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.4			60	96.9						
70	98.4			70	98.9						
80	99.9			80	100.1						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.147 V + 37.474	-0.927
West*	SN = -0.076 V + 32.827	-0.743

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 9 LOCATION STA 179 + 70 to 183 + 85

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Limestone	Beamish (Brown) $1/_2$" stone
1. F. AGG	45	Sand & Igneous	Ormell sand and Maple Ridge unwashed Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	10.453	
MARSHALL FLOW	14.7	
V.M.A. % VOL.	12.7	
VOIDS % VOL.	2.0	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.10670(n=3) BWP -	0.00780	7.312	0.92503	0.07575	8.189	2.11050	0.07787	3.690
LN West WP 0.10641(n=1) BWP —	--	--	1.06820	--	--	2.14520	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.4	36.1	0.981	2.715	31.0	35.0	1.711	4.893				
39.1	35.0	0.778	2.219	38.6	32.1	0.629	1.958				
50.7	32.4	0.981	3.032	51.7	31.5	0.850	2.697				
58.6	32.4	0.200	0.617	62.2	29.6	0.472	1.595				
70.2	30.1	0.970	3.018	71.8	28.4	1.914	6.747				
79.1	28.9	1.610	5.572	81.7	30.4	2.193	7.214				
90.9	29.2	0.353	1.209	94.6	27.7	0.833	3.002				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.1			60	96.6						
70	98.4			70	98.6						
80	99.7			80	99.9						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.132\ V + 39.821$	-0.926
West*	$SN = -0.097\ V + 36.703$	-0.804

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 10 LOCATION STA 183 + 85 to 188 + 00

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Limestone	Beamish (Brown) $1/_2$" stone
1. F. AGG	45	Igneous	Maple Ridge unwashed screening
2. F. AGG.			
MIN FILLER			
% ASP	4.7	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	10.809	
MARSHALL FLOW	16.9	
V.M.A. % VOL.	12.3	
VOIDS % VOL.	1.5	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN WP BWP	East 0.10886(n=3) -	0.00528	4.850	0.74283	0.11512	15.499	2.01623	0.04556	2.260
LN WP BWP	West 0.098011(n=1) --	--	--	0.96730	--	--	2.10980	--	--
LN WP BWP									

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.9	38.9	1.372	3.525	30.4	39.1	1.603	4.102				
40.0	37.7	0.989	2.626	39.7	35.3	1.183	3.352				
49.8	36.7	0.643	1.750	52.0	33.6	1.311	3.903				
59.6	36.2	0.611	1.686	61.8	32.7	0.436	1.333				
69.3	32.9	0.702	2.133	72.4	31.1	2.145	6.906				
79.8	31.3	2.141	6.845	82.7	33.6	2.823	8.418				
89.7	32.4	0.495	1.525	93.8	30.6	0.702	2.293				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.0			60	96.3						
70	97.6			70	98.4						
80	99.3			80	99.4						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.139\ V + 43.361$	-0.895
West*	$SN = -0.115\ V + 40.754$	-0.803

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 11 LOCATION STA 188 + 00 to 192 + 15

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Igneous	Maple Ridge $^{1}/_{2}$" Stone
1. F. AGG	45	Igneous	Maple Ridge unwashed screenings
2. F. AGG.			
MIN FILLER			
% ASP	5.0		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	10.564	
MARSHALL FLOW	16.2	
V.M.A. % VOL.	13.7	
VOIDS % VOL.	3.0	

C. AGG. PROPERTIES

PSV = 46
AAV = 2.2
LA. = 16
PN. = 104

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	East								
WP	0.07801(n=18)	0.00418	5.356	0.66927	0.08837	13.204	1.92908	0.11673	6.051
BWP	0.08115(n=9)	0.00339	4.177	0.57941	0.04947	8.539	1.98579	0.08169	4.114
LN	West								
WP	0.08017(n=1)	--	--	0.59220	--	--	1.93730	--	--
BWP	--								
LN									
WP									
BWP									

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
32.5	43.4	1.347	3.102	30.6	44.8	1.135	2.533				
40.8	43.5	0.424	0.975	38.8	42.1	0.974	2.316				
50.7	40.2	0.907	2.255	51.3	40.1	1.357	3.389				
61.0	38.5	0.833	2.161	61.2	39.5	0.495	1.248				
70.6	35.8	1.493	4.171	71.1	35.8	2.136	5.961				
80.1	34.3	2.431	7.077	82.2	38.8	3.111	8.019				
89.9	35.0	0.777	2.219	92.6	35.2	1.289	3.667				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.5			60	96.9						
70	98.5			70	98.5						
80	100.0			80	99.6						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.181\ V + 49.521$	-0.917
West*	$SN = -0.143\ V + 48.108$	-0.868

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay)   DATE CONSTRUCTED 1978

TEST SECT 12   LOCATION STA 192 + 15 to 196 + 30

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Igneous	Maple Ridge $1/_2$" Stone
1. F. AGG	45	Limestone	Beamish (Brown) unwashed Screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	10.542	
MARSHALL FLOW	21.2	
V.M.A. % VOL.	11.8	
VOIDS % VOL.	2.0	

C. AGG. PROPERTIES

PSV = 46
AAV = 2.2
LA. = 16
PN. = 104

PAVEMENT REFLECTANCE PROPERTIES   DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.09023(n=3) BWP -	0.00321	3.559	0.50363	0.03539	7.028	1.79657	0.05883	3.275
LN West WP 0.07243(n=1) BWP --	--	--	0.65890	--	--	1.95110	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.0	42.2	1.066	2.523	30.7	44.9	1.424	3.171				
40.7	40.4	0.424	1.050	39.6	39.6	0.947	2.388				
51.6	36.8	1.069	2.903	52.1	39.6	0.577	1.459				
60.6	37.0	0.777	2.101	61.7	38.1	0.360	0.946				
70.8	34.1	1.629	4.782	71.0	35.3	1.761	4.995				
80.8	32.1	1.676	5.214	80.8	37.1	3.085	8.326				
90.4	34.4	0.848	2.467	91.1	32.8	2.351	7.169				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.9			60	97.1						
70	99.0			70	99.0						
80	100.6			80	100.5						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.169 V + 46.803	-0.904
West*	SN = -0.163 V + 48.148	-0.859

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 13 LOCATION STA 196 + 30 to 200 + 45

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Igneous & L Stone 1:1	Blend of Maple Ridge and Beamish $^1/_2$" stone
1. F. AGG	45	Limestone	Beamish unwashed screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	10.630	
MARSHALL FLOW	17.1	
V.M.A. % VOL.	12.2	
VOIDS % VOL.	1.9	

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 21
PN. = 109

PAVEMENT REFLECTANCE PROPERTIES DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.09722(n=3) BWP -	0.00533	5.490	0.72113	0.11378	15.779	1.91123	0.06254	3.272
LN West WP 0.90602(n=1) BWP --	--	--	0.58740	--	--	1.96820	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.4	38.3	1.3937	3.641	30.7	39.4	0.9323	2.368				
40.5	36.6	0.2121	0.579	38.6	37.0	0.6455	1.742				
51.2	35.1	2.4906	7.089	51.1	34.9	0.3464	0.993				
61.1	34.2	0.1732	0.506	61.1	34.2	1.1060	3.237				
69.7	31.0	1.3317	4.300	70.3	32.5	1.7673	5.432				
80.2	30.0	2.1267	7.080	80.4	33.0	2.8023	8.501				
91.1	30.8	0.7778	2.521	90.0	31.4	2.0232	6.450				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.9			60	96.9						
70	98.8			70	99.1						
80	100.7			80	100.4						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.151\ V + 42.751$	-0.888
West*	$SN = -0.126\ V + 42.273$	-0.876

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay)　DATE CONSTRUCTED 1978

TEST SECT 14　LOCATION STA 200 + 45 to 204 + 60

TEST SECT DESCRIPTION

MIX TYPE D.F.C.

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Limestone	Beamish (Brown) $1/_2$" Stone
1. F. AGG	45	Limestone	Beamish unwashed screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.5	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHAL STABILITY	9.341	
MARSHALL FLOW	20.3	
V.M.A. % VOL.	11.9	
VOIDS % VOL.	1.7	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES　DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.11391(n=3) BWP -	0.01233	10.825	0.78580	0.24336	30.970	1.91873	0.14192	7.397
LN West WP 0.12038(n=1) BWP --	--	--	1.50640	--	--	2.41820	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION **PAGE 2**

SKID MEASUREMENTS **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.5	32.6	0.8883	2.723	30.0	33.6	1.0247	3.045				
40.3	32.7	1.0606	3.239	37.4	30.9	0.3775	1.223				
51.4	28.6	1.2767	4.404	51.8	28.9	0.5291	1.831				
61.0	29.0	1.1269	3.886	60.5	28.2	0.9539	3.383				
70.9	26.9	1.2503	4.637	70.6	27.1	2.2338	8.243				
80.6	27.1	1.7515	6.473	80.4	27.2	2.3158	8.504				
91.8	26.3	0.4243	1.613	89.9	28.2	4.7930	17.017				

NOISE LEVEL MEASUREMENT **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.4			60	96.4						
70	98.7			70	98.5						
80	100.4			80	100.2						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.111\ V + 35.748$	-0.855
West*	$SN = -0.096\ V + 34.973$	-0.690

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 15 LOCATION STA 204 + 60 to 208 + 75

TEST SECT DESCRIPTION

MIX TYPE HL 3 Control

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Limestone	Beamish (Brown) $^1/_2$" Stone
1. F. AGG	55	Sand	Ormell Sands
2. F. AGG.			
MIN FILLER			
% ASP	5.2	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHAL STABILITY	7.028	
MARSHALL FLOW	10.0	
V.M.A. % VOL.	14.8	
VOIDS % VOL.	3.3	

C. AGG. PROPERTIES

PSV = 43
AAV = N.T.
LA. = 26
PN. = 114

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ QO	σ QO	CV QO	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	East								
WP	0.12495(n=14)	0.00775	6.200	1.16656	0.22675	19.438	2.35963	0.19871	8.421
BWP	0.1233 (n=7)	0.00638	5.267	0.98609	0.18018	18.273	2.25894	0.16896	7.480
LN	West								
WP	0.13466(n=1)	--	—	1.59810	--	—	2.83020	--	--
BWP									
LN									
WP									
BWP									

PAVEMENT CLASSIFICATION
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SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.7	30.3	0.7326	2.414	29.6	31.2	1.5217	4.881				
40.3	30.3	0.4243	1.400	37.4	28.4	1.0116	3.556				
51.2	26.3	0.8021	3.054	52.2	26.3	0.2886	1.099				
61.0	26.6	1.1060	4.153	60.4	25.7	1.3453	5.235				
69.9	23.8	0.5291	2.223	71.0	24.3	1.9975	8.220				
81.0	22.6	1.5485	6.864	81.7	23.9	1.6653	6.958				
90.4	21.7	1.2728	5.865	91.1	22.7	0.2082	0.916				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	95.7			60	96.4						
70	98.1			70	98.6						
80	99.7			80	99.7						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.156 V + 35.302	-0.944
West*	SN = -0.128 V + 33.832	-0.908

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay) DATE CONSTRUCTED 1978

TEST SECT 16 LOCATION STA 208 + 75 to 212 + 90

TEST SECT DESCRIPTION

MIX TYPE Delugnip

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	63	Igneous & Lime stone 1.7:1	Blend of Maple Ridge and Beamish (Brown) $3/_8$" Stone
1. F. AGG	37	Igneous	Maple Ridge unwashed screenings
2. F. AGG.			
MIN FILLER			
% ASP	4.3	60/70 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHAL STABILITY	10.141	
MARSHALL FLOW	19.8	
V.M.A. % VOL.	12.5	
VOIDS % VOL.	3.5	

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 19
PN. = 107

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East WP 0.08406(n=3) BWP --	0.00327	3.892	0.60583	0.20449	33.755	1.90613	0.13868	7.276
LN West WP 0.09117(n=1) BWP	-	0	0.57770	--	--	1.92280	--	--
LN WP BWP								

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.3	41.2	0.8544	2.071	29.3	41.9	0.7958	1.899				
38.7	42.8	2.5456	5.948	36.4	39.4	0.7274	1.847				
49.7	37.3	1.2741	3.413	49.4	37.7	0.1414	0.375				
59.3	37.6	1.3747	3.656	58.2	37.0	1.1136	3.010				
70.6	36.0	0.9866	2.738	70.4	34.9	1.8175	5.203				
79.2	34.7	2.3973	6.905	80.6	36.6	3.1880	8.718				
88.6	36.3	1.3435	3.696	91.2	37.4	5.8286	15.599				

NOISE LEVEL MEASUREMENT

DATE

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.8			60	97.3						
70	98.5			70	98.9						
80	100.4			80	100.4						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	SN = -0.123 V + 45.024	-0.801
West*	SN = -0.080 V + 42.679	-0.571

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 7 (Lindsay)   DATE CONSTRUCTED 1978

TEST SECT 17   LOCATION STA 212 + 90 to 217 + 05

TEST SECT DESCRIPTION

MIX TYPE HL1 Control

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	(Ig). Trap $1/_2$ Stone	Havelock
1. F. AGG	45	Sand	Ormell Sand
2. F. AGG.			
MIN FILLER			
% ASP	5.3	85/100 Pen.	

MIX CHARACTERISTICS

	LAB	FIELD
MARSHAL STABILITY	8.674	
MARSHALL FLOW	11.3	
V.M.A. % VOL.	15.0	
VOIDS % VOL.	3.5	

C. AGG. PROPERTIES

PSV = 46
AAV = 2.2
LA. = 12
PN. = 103

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN East									
WP	0.08589(n=14)	0.00576	6.693	0.57947	0.08900	17.133	1.78738	0.08486	4.748
BWP	0.09427(n=7)	0.00489	5.194	0.44873	0.05871	13.085	1.77387	0.06078	3.427
LN West									
WP	0.07059(n=1)	--	--	1.01140	--	--	2.30840	--	--
BWP									
LN									
WP									
BWP									

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.4	48.7	2.9680	6.098	29.5	46.6	2.1282	4.564				
37.6	46.6	3.8891	8.337	37.6	42.9	.9110	2.121				
49.8	43.0	2.8160	6.549	49.4	40.8	1.7502	4.293				
59.3	41.6	0.7810	1.877	57.0	40.6	.8021	1.974				
70.5	36.6	1.0016	2.739	69.9	36.6	1.0016	2.734				
78.6	34.3	1.6401	4.782	79.4	36.5	2.8361	7.777				
88.8	33.8	0.9899	2.929	89.9	33.4	1.7156	5.142				

NOISE LEVEL MEASUREMENT **DATE**

LINE-East West

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	95.8			60	96.6						
70	97.9			70	99.1						
80	99.8			80	100.6						

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
East	$SN = -0.287V + 57.572$	-0.947
West*	$SN = -0.203V + 51.584$	-0.941

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 1 LOCATION Toronto-by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Trap-rock	
1. F. AGG	41	Natural Sand	
2. F. AGG.	14	Limestone	
MIN FILLER			
% ASP	5.4		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.22	11.63
MARSHALL FLOW	2.64	2.95
V.M.A. % VOL.	16.90	17.50
VOIDS % VOL.	2.80	3.7

C. AGG. PROPERTIES

PSV = 43
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	Driving								
WP	.091010	0.00317	3.49	1.0985	0.1256	11.44	2.3607	0.0912	3.86
BWP	.08400	0.00248	2.96	1.0120	0.1192	11.78	2.4728	0.0712	2.88
LN	Center								
WP	.08018	0.00561	7.00	1.4703	0.5317	36.16	2.6726	0.3155	11.81
BWP	.08881	0.00891	10.04	0.9171	0.3838	41.85	2.3570	0.2837	12.04
LN	Passing								
WP	.08807	0.00652	7.41	0.7227	0.1225	16.94	2.0904	0.1015	4.86
BWP	.09583	0.00311	3.25	0.6799	0.1054	15.50	2.2297	0.0764	3.42

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-Driving Center Passing

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.00	38.17	0.651	1.70	30.08	42.04	4.07	9.67	31.63	42.47	1.51	3.57
39.47	35.70	0.436	1.22	39.67	35.60	0.17	0.49	39.68	40.70	1.64	4.03
50.52	30.80	0.868	2.82	51.27	33.93	1.56	4.59	50.03	37.60	1.56	4.15
59.73	27.27	1.457	5.34	60.00	31.53	1.54	4.87	60.35	34.10	0.99	2.90
70.97	25.83	0.153	0.59	70.27	27.50	1.13	4.13	72.97	32.30	1.37	4.26
80.00	23.55	1.997	8.48	79.60	25.33	1.46	5.75	80.20	29.13	3.64	12.48
90.15	22.70	2.404	10.59	90.67	22.67	1.68	7.41	90.50	26.93	0.35	1.30
100.07	23.10	0.436	1.89	99.70	20.30	0.36	1.78	102.00	23.93	1.04	4.35

NOISE LEVEL MEASUREMENT

DATE

LINE-Driving Center Passing

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	99.3			60	98.6			60	99.0		
70	101.8			70	101.2			70	101.3		
80	103.5			80	103.3			80	103.4		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	SN = -0.231 V + 43.315	-0.936
C	SN = -0.302 V + 49.681	-0.960
P	SN = -0.268 V + 51.134	-0.983

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 2 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Trap-rock	
1. F. AGG	41	Natural Sands	
2. F. AGG.	14	Trap-rock Screening	
MIN FILLER			
% ASP	5.3		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.22	12.77
MARSHALL FLOW	2.64	3.40
V.M.A. % VOL.	17.2	15.0
VOIDS % VOL.	3.0	0.80

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.2
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:1982

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	Driving								
WP	0.10506	0.00210	2.00	1.3719	0.3672	26.77	2.8735	0.3193	11.11
BWP	0.08740	0.00485	5.55	1.2509	0.2931	23.43	2.7202	0.2342	8.81
LN	Center								
WP	0.09164	0.0103	11.22	1.2662	0.1908	15.07	2.5946	0.2484	9.57
BWP	0.08587	0.00415	4.83	1.4319	0.1716	11.07	2.8024	0.1141	4.07
LN	Passing								
WP	0.08292	0.00246	2.97	0.6514	0.0899	13.80	1.9875	0.0937	4.72
BWP	0.08072	0.00698	8.65	0.6778	0.1788	26.38	2.1715	0.1862	8.58

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-Driving				Center				Passing			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.70	39.37	1.4364	3.65	29.60	43.54	3.4522	7.93	30.45	45.75	4.5735	9.99
39.43	36.70	1.1532	3.14	40.30	37.07	0.2082	0.56	39.94	42.52	1.4007	3.29
50.72	32.07	0.9106	2.84	52.03	34.08	1.3650	3.91	49.73	39.73	0.4933	1.24
60.57	27.00	1.7692	6.55	60.13	31.87	1.2097	3.79	60.47	38.03	0.3214	0.84
70.73	24.80	1.0000	4.032	70.10	29.80	1.2767	4.28	70.80	34.43	1.1015	3.20
81.40	22.10	0.3830	1.73	78.76	26.17	1.0017	3.83	78.20	31.40	1.6703	5.32
90.07	20.83	1.6773	8.05	91.97	23.97	1.9630	8.19	89.40	28.50	0.4965	1.74
99.30	21.15	0.0707	0.33	101.00	21.40	1.1269	5.27	100.47	26.57	0.9291	3.50

NOISE LEVEL MEASUREMENT

DATE

LINE-Driving				Center				Passing			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.8			60	98.5			60	98.8		
70	99.8			70	100.6			70	101.0		
80	101.4			80	102.6			80	102.9		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	SN = -0.297 V + 47.244	-0.962
C	SN = -0.302 V + 50.980	-0.968
P	SN = -0.279 V + 53.943	-0.964

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
LA	Los Angeles abrasion
D.	Driving Lane
C.	Centre Lane
P.	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 3 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Trap-rock	
1. F. AGG	55	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	--		
% ASP	4.0		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	14.16	15.15
MARSHALL FLOW	4.21	3.91
V.M.A. % VOL.	12.9	13.5
VOIDS % VOL.	1.2	2.0

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.07263		6.137	0.8029		5.893	2.2646		2.172
BWP	0.06667		6.079	0.7035		27.073	2.2988		9.322
LN C									
WP	0.07392		6.888	0.8074		4.657	2.2099		4.580
BWP	0.06879		6.244	0.7653		3.731	2.2757		1.211
LN P									
WP	0.06991		3.885	0.5786		12.066	2.0487		0.987
BWP	0.07164		5.942	0.5950		24.165	2.1329		4.672

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS **DATE**

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.03	40.60	0.872	2.147	25.00	44.98	2.803	6.232	30.65	48.53	2.761	5.690
40.13	38.93	0.808	2.076	40.27	40.10	0.954	2.379	40.44	46.36	2.473	5.335
52.27	34.83	0.503	1.445	51.23	38.60	1.800	4.663	49.80	43.90	0.854	1.946
60.37	31.40	0.656	2.088	60.20	36.50	1.400	3.836	60.50	42.10	0.700	1.663
70.17	31.73	0.808	2.547	71.57	32.80	1.992	6.075	68.83	40.17	2.082	5.183
81.35	28.80	0.356	1.236	78.80	30.20	1.852	6.133	78.50	36.47	2.150	5.896
90.67	27.43	1.484	5.411	92.30	27.70	0.854	3.084	89.98	33.18	0.776	2.340
98.95	27.75	0.212	0.764	100.23	26.23	0.404	1.541	100.63	30.77	1.274	4.141

NOISE LEVEL MEASUREMENT **DATE**

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	99.0			60	99.0			60	97.8		
70	101.0			70	100.9			70	100.2		
80	103.1			80	103.4			80	101.8		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.205\ V + 46.030$	-0.959
C	$SN = -0.265\ V + 52.024$	-0.972
P	$SN = -0.258\ V + 56.877$	-0.966

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 4 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	55	Trap-rock	
1. F. AGG	34	Natural Sand	
2. F. AGG.	11	Limestone Screening	
MIN FILLER	--		
% ASP	4.8		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.69	13.46
MARSHALL FLOW	2.60	3.14
V.M.A. % VOL.	16.0	14.2
VOIDS % VOL.	2.7	1.2

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2.
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.08173		4.853	1.3856		14.853	2.6749		4.948
BWP	0.07330		2.451	0.9909		20.833	2.6453		8.487
LN C									
WP	0.07461		1.477	0.9496		16.872	2.2525		5.670
BWP	0.07294		4.388	0.8579		14.180	2.3306		2.518
LN P									
WP	0.07424		5.524	0.5781		25.684	1.9302		7.806
BWP	0.07528		6.488	0.6625		38.461	2.0830		11.712

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.93	39.17	0.907	2.317	29.96	40.86	1.953	4.779	30.85	45.85	1.794	3.912
40.27	36.33	0.862	2.373	40.93	34.8	0.300	0.862	40.60	44.46	2.083	4.685
50.90	33.13	0.818	2.470	51.93	34.63	1.097	3.167	50.83	40.63	0.702	1.729
60.10	29.93	0.611	2.112	59.30	32.13	1.206	3.752	61.10	39.07	0.404	1.035
70.03	29.07	1.537	5.289	70.20	30.07	1.250	4.159	69.97	35.93	0.751	2.089
80.78	27.13	0.532	1.959	78.33	28.23	0.923	3.272	79.77	32.93	1.457	4.425
91.37	25.27	1.305	5.165	91.90	25.87	1.704	6.587	91.08	29.80	0.898	3.014
98.95	23.55	0.071	0.300	99.63	24.53	0.462	1.883	100.97	27.53	0.874	3.173

NOISE LEVEL MEASUREMENT

DATE

LINE-

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	99.2			60	99.0			60	99.0		
70	101.4			70	101.6			70	101.2		
80	103.3			80	103.5			80	103.3		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.218\ V + 44.543$	-0.963
C	$SN = -0.224\ V + 46.122$	-0.959
P	$SN = -0.272\ V + 54.911$	-0.981

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 5 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	60	Trap-rock	
1. F. AGG	28	Natural sands	
2. F. AGG.	10	Limestone screening	
MIN FILLER	2	Short fibre asbestos	
% ASP	5.7		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	8.00	8.46
MARSHALL FLOW	3.83	5.74
V.M.A. % VOL.	14.2	16.0
VOIDS % VOL.	1.0	0.9

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	D								
WP	0.08191		7.163	0.8714		13.693	2.187		4.253
BWP	0.07288		9.730	0.8944		38.855	2.3661		11.257
LN	C								
WP	0.07080		3.217	0.8255		18.709	2.1882		8.306
BWP	0.07905		9.217	1.0103		67.359	2.5254		32.123
LN	P								
WP	0.07497		5.256	0.4952		22.730	1.9012		6.169
BWP	0.07397		9.576	0.5033		20.366	1.9461		2.456

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.00	38.97	1.002	2.571	30.14	41.34	2.770	6.701	32.85	44.70	1.374	3.073
41.13	37.07	1.242	3.352	41.50	34.93	1.069	3.061	40.32	42.48	0.901	2.121
51.50	33.50	1.687	5.036	52.60	33.63	0.777	2.309	50.07	40.17	0.404	1.006
61.17	29.60	1.249	4.220	59.73	32.27	1.557	4.825	61.10	38.27	0.503	1.315
71.43	28.17	1.940	6.887	71.40	29.07	1.422	4.894	71.33	35.60	0.963	1.946
81.27	25.88	1.066	4.119	79.67	26.80	0.954	3.559	80.23	32.63	1.436	4.402
91.27	25.40	1.000	3.937	91.03	25.27	0.907	3.591	91.10	29.45	0.300	1.019
98.50	24.13	1.457	6.038	99.57	23.60	0.781	0.781	101.10	27.47	1.097	3.994

NOISE LEVEL MEASUREMENT

DATE

LINE-

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	99.6			60	99.8			60	99.0		
70	102.0			70	102.1			70	101.3		
80	104.0			80	103.9			80	103.5		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.228\ V + 45.350$	-0.956
C	$SN = -0.247\ V + 47.226$	-0.957
P	$SN = -0.253\ V + 53.031$	-0.991

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 6 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	60	Trap-rock	
1. F. AGG	38	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	2	Short Fibre Asbestos	
% ASP	5.4		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	9.74	11.43
MARSHALL FLOW	5.80	4.77
V.M.A. % VOL.	15.2	18.6
VOIDS % VOL.	1.0	3.4

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D								
WP 0.068765		10.489	1.5830		23.037	2.8849		10.546
BWP 0.062466		11.539	1.4058		16.969	2.6384		5.870
LN C								
WP 0.06626		2.947	1.5928		2.565	2.6707		2.591
BWP 0.06010		3.253	1.4566		18.667	2.6798		9.116
LN P								
WP 0.06242		6.693	1.1510		9.243	2.3496		5.953
BWP 0.06152		7.122	1.2608		18.975	2.4792		9.396

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SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.70	40.73	1.365	3.351	30.06	42.96	2.303	5.360	32.53	45.88	1.803	3.929
41.17	39.57	0.603	1.523	40.40	37.83	0.493	1.304	41.07	43.90	0.854	1.946
51.95	35.58	1.276	3.588	50.87	40.13	1.332	3.318	50.27	42.30	1.803	4.262
60.40	32.27	1.193	3.697	59.10	37.10	1.905	5.135	60.33	42.43	0.833	1.962
69.87	33.47	0.252	0.752	70.63	35.07	2.013	5.741	71.73	37.93	2.108	5.557
80.85	28.83	1.087	3.773	79.20	33.03	1.790	5.418	79.90	36.43	2.466	6.770
90.47	28.37	1.656	5.839	90.73	29.40	0.265	0.900	90.48	32.53	0.340	1.046
97.90	28.77	0.896	3.116	98.63	27.77	0.586	2.110	99.33	29.40	1.253	4.262

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.8			60	98.7			60	98.2		
70	100.5			70	100.8			70	100.6		
80	102.1			80	102.8			80	102.3		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.198\ V + 46.333$	-0.940
C	$SN = -0.209\ V + 48.996$	-0.939
P	$SN = -0.236\ V + 54.385$	-0.955

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 7 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Mod HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Steel Slag	
1. F. AGG	55	Steel Slag Screening	
2. F. AGG.	--		
MIN FILLER	--		
% ASP	5.2		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	15.65	16.18
MARSHALL FLOW	4.08	3.37
V.M.A. % VOL.	18.5	18.7
VOIDS % VOL.	2.7	3.3

C. AGG. PROPERTIES

PSV = 59
AAV = 4.3
LA. = 30.0
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D WP 0.07772 BWP 0.07713		5.192 6.741	0.7320 0.5943		18.218 12.921	2.4326 2.580		5.479 1.377
LN C WP 0.07114 BWP 0.06963		3.558 2.688	0.7473 0.7735		2.406 10.975	2.4013 2.5265		0.493 9.032
LN P WP 0.06384 BWP 0.06689		2.467 3.517	0.5424 0.6524		11.960 20.233	2.0387 2.2637		4.594 6.293

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.43	53.70	0.964	1.796	29.86	55.52	2.019	3.637	33.50	56.43	1.350	2.393
40.40	49.67	0.907	1.827	38.73	49.23	0.808	1.642	39.52	54.20	1.620	2.989
51.05	44.55	1.353	3.037	50.73	46.10	0.889	1.928	51.30	50.63	1.002	1.978
60.37	38.13	1.193	3.129	58.43	42.17	1.290	3.059	59.60	49.07	0.451	0.919
69.10	37.53	0.777	2.069	69.93	38.67	0.651	1.683	70.50	45.93	0.709	1.545
80.43	35.13	1.597	4.546	78.23	35.57	1.950	5.483	78.33	41.57	1.350	3.249
90.13	33.37	1.882	5.641	90.03	33.40	1.217	3.642	89.83	38.55	1.266	3.285
97.37	32.43	0.208	0.642	98.27	30.60	0.608	1.988	97.73	35.57	1.365	3.838

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.8			60	98.1			60	97.3		
70	100.1			70	99.6			70	99.4		
80	101.6			80	102.0			80	101.0		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.318\ V + 61.119$	-0.959
C	$SN = -0.357\ V + 64.483$	-0.981
P	$SN = -0.318\ V + 67.119$	-0.985

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 8 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Mod HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	50	Steel Slag	
1. F. AGG	38	Natural Sand	
2. F. AGG.	12	Limestone Screening	
MIN FILLER	--		
% ASP	5.7		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	9.60	13.29
MARSHALL FLOW	3.29	3.50
V.M.A. % VOL.	17.3	17.7
VOIDS % VOL.	2.3	1.9

C. AGG. PROPERTIES

PSV = 59
AAV = 4.3
LA. = 30.0
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	D								
WP	0.08463		10.319	1.7020		10.029	3.1503		10.296
BWP	0.08358		7.325	2.1101		12.584	3.5657		5.551
LN	C								
WP	0.08113		8.585	1.4012		7.071	2.7031		10.371
BWP	0.07849		7.104	1.9477		19.106	3.3683		4.504
LN	P								
WP	0.07025		12.809	1.3115		23.390	2.4743		7.835
BWP	0.07699		7.193	1.9892		13.473	3.2843		8.374

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
28.37	48.53	0.611	1.259	28.76	46.60	5.787	12.419	30.03	44.70	1.042	2.332
39.83	43.30	0.265	0.661	38.53	40.53	5.279	13.023	39.44	41.62	1.931	4.639
48.25	40.40	0.283	0.700	48.47	42.87	1.550	3.616	49.57	40.33	2.673	6.627
59.00	33.60	0.600	1.786	59.43	36.97	1.332	3.602	60.00	36.50	0.954	2.614
68.93	33.07	1.242	3.757	69.77	35.43	0.874	2.466	77.17	33.13	1.665	5.026
79.60	29.47	1.531	5.195	78.27	30.77	1.193	3.878	31.57	31.57	1.150	3.644
90.57	27.63	1.914	6.926	89.47	29.77	1.704	5.724	89.85	26.85	0.961	3.579
97.80	24.83	0.709	2.857	98.27	27.80	1.114	4.006	98.13	26.60	1.752	6.587

NOISE LEVEL MEASUREMENT

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.3			60	98.7			60	97.6		
70	100.4			70	100.6			70	99.7		
80	102.1			80	102.5			80	101.7		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.329\ V + 56.152$	-0.977
C	$SN = -0.272\ V + 53.768$	-0.907
P	$SN = -0.280\ V + 53.079$	-0.972

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401	DATE CONSTRUCTED 1984
TEST SECT 9	LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Mod HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Blast Furnace Slag	
1. F. AGG	55	Blast Furnace Screenings	
2. F. AGG.	--		
MIN FILLER	--		
% ASP	7.8		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	12.58	14.79
MARSHALL FLOW	3.27	3.80
V.M.A. % VOL.	24.0	23.1
VOIDS % VOL.	6.9	6.1

C. AGG. PROPERTIES

PSV = 54
AAV = 13.4
LA. = 47.2
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	D								
WP	0.08606		2.447	0.6945		8.121	1.9889		3.651
BWP	0.07635		7.414	0.5313		20.585	2.0172		6.977
LN	C								
WP	0.07435		1.814	0.5930		6.187	1.9130		1.711
BWP	0.07314		3.886	0.5400		2.905	2.0046		1.075
LN	P								
WP	0.07809		5.696	0.5080		5.769	1.8069		0.884
BWP	0.07944		7.081	0.5500		4.163	1.9256		1.535

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
28.27	52.73	2.031	3.851	28.06	52.62	1.003	1.907	29.65	54.80	1.707	3.115
40.00	49.50	1.873	3.785	38.80	44.93	1.193	2.655	40.76	49.58	0.672	1.356
47.53	46.23	0.208	0.450	48.37	43.70	0.173	0.396	48.53	48.10	1.179	2.451
59.00	40.63	2.214	5.450	58.83	39.67	1.986	5.006	61.67	45.30	0.700	1.545
70.10	37.50	0.964	2.572	69.70	36.07	0.379	1.050	70.50	43.50	0.608	1.398
80.07	35.80	2.981	8.329	78.77	34.03	1.604	4.714	78.70	40.83	1.756	4.300
91.30	30.07	0.289	0.960	90.20	34.33	0.862	2.511	89.23	38.73	1.109	2.863
98.20	30.80	1.819	5.970	98.03	33.33	0.473	1.418	99.93	36.80	1.229	3.339

NOISE LEVEL MEASUREMENT

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.5			60	98.6			60	98.4		
70	99.0			70	100.6			70	100.5		
80	100.5			80	102.4			80	102.3		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.335\ V + 61.941$	-0.976
C	$SN = -0.270\ V + 57.256$	-0.944
P	$SN = -0.244\ V + 60.544$	-0.975

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 10 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Mod. HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	40	Blast Furnace Slag	
1. F. AGG	45	Natural Sand	
2. F. AGG.	15	Limestone Screenings	
MIN FILLER	-		
% ASP	6.5		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	8.78	14.03
MARSHALL FLOW	2.66	2.48
V.M.A. % VOL.	17.9	17.0
VOIDS % VOL.	2.9	2.2

C. AGG. PROPERTIES

PSV = 45
AAV = 13.4
LA. = 47.2
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D								
WP 0.09298		9.706	1.0792		15.018	2.5132		4.931
BWP 0.09375		4.553	1.2044		16.267	2.9510		7.745
LN C								
WP 0.08930		2.637	1.0113		2.376	2.4589		4.027
BWP 0.08382		3.772	1.1018		7.213	2.6407		3.623
LN P								
WP 0.08432		1.774	0.6519		6.638	1.9297		2.060
BWP 0.08896		1.399	0.8373		4.152	2.2846		0.911

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.07	44.70	0.700	1.566	29.48	46.20	1.875	4.058	29.98	49.25	0.520	1.055
41.03	40.80	1.709	4.188	39.13	40.90	0.755	1.846	40.94	44.84	1.036	2.310
48.63	36.50	1.136	3.112	49.47	39.27	1.250	3.184	50.00	41.33	0.503	1.218
58.90	30.97	1.779	5.774	59.73	34.33	2.120	6.174	60.90	38.13	1.401	3.674
72.03	29.43	1.537	5.223	69.80	30.53	0.153	0.500	71.37	35.57	1.172	3.295
81.93	35.37	2.281	8.992	79.43	27.37	2.205	8.058	80.40	33.03	1.193	3.612
92.38	23.50	1.417	6.028	90.90	26.37	1.350	5.121	89.78	30.13	0.287	0.953
99.03	23.83	0.764	3.205	100.20	24.60	0.200	0.813	101.47	28.27	0.551	1.948

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.3			60	98.2			60	98.2		
70	100.1			70	100.8			70	100.9		
80	101.7			80	102.9			80	102.1		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	SN = -0.312 V + 52.274	-0.967
C	SN = -0.309 V + 53.735	-0.969
P	SN = -0.295 V + 56.936	-0.987

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 11 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Sand Mix

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	14	Trap-rock	
1. F. AGG	84	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	2	Short Fibre Asbestos	
% ASP	7.0		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	9.27	9.67
MARSHALL FLOW	6.94	10.26
V.M.A. % VOL.	17.7	19.5
VOIDS % VOL.	0.0	0.2

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.07451		3.673	1.4267		2.295	2.9739		1.698
BWP	0.06005		4.529	1.3703		8.779	2.8479		0.927
LN C									
WP	0.06613		1.010	1.2039		3.174	2.5931		1.255
BWP	0.06483		10.578	1.2966		18.935	2.9626		15.539
LN P									
WP	0.05897		0.795	1.0245		19.310	2.4806		11.772
BWP	0.06374		11.738	1.3743		3.352	2.9904		5.513

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SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.43	48.47	1.002	2.067	30.48	51.40	1.432	2.786	30.03	53.40	2.066	3.870
40.27	44.60	1.916	4.295	40.00	45.23	0.666	1.472	40.08	50.92	1.438	2.823
50.67	39.87	1.159	2.907	52.63	42.93	2.706	6.303	51.07	45.90	0.656	1.429
61.13	33.90	0.529	1.561	59.57	39.73	3.721	9.364	61.13	44.93	0.896	1.995
71.37	33.07	2.237	6.756	69.93	35.87	0.603	1.681	69.37	40.37	0.862	2.136
80.37	29.63	1.422	4.800	80.33	31.83	1.893	5.947	80.33	36.10	1.670	4.627
90.63	28.30	1.473	5.205	91.57	31.00	1.127	3.635	90.53	33.23	1.103	3.319
98.35	26.80	0.424	1.583	99.47	27.70	1.386	5.002	100.07	28.43	1.877	6.602

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.2			60	97.2			60	96.5		
70	99.3			70	99.3			70	98.7		
80	101.3			80	101.2			80	100.5		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.325\ V + 56.681$	-0.968
C	$SN = -0.337\ V + 60.361$	-0.975
P	$SN = -0.354\ V + 64.856$	-0.986

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 12 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Sand Mix

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	9	Trap-rock	
1. F. AGG	89	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	2	Short Fibre Asbestos	
% ASP	7.2		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	11.78	4.90
MARSHALL FLOW	8.38	11.51
V.M.A. % VOL.	16.8	20.7
VOIDS % VOL.	0.0	1.1

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D								
WP 0.07492		7.062	1.2853		1.677	2.8487		5.057
BWP 0.06320		3.811	1.3034		10.978	2.8232		5.973
LN C								
WP 0.06833		1.798	0.9292		3.932	2.3701		1.470
BWP 0.06347		4.801	1.3048		4.946	2.8618		7.672
LN P								
WP 0.06448		3.246	0.8302		6.664	2.1862		6.335
BWP 0.06475		7.303	1.0945		10.349	2.5238		6.476

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.67	47.97	1.026	2.140	28.83	51.35	1.139	2.218	30.40	55.30	2.106	3.808
40.07	44.13	0.802	1.817	36.93	45.03	1.464	3.251	39.58	52.03	0.776	1.492
48.10	40.63	1.815	4.466	50.80	43.73	2.122	4.852	49.57	48.20	0.346	0.719
60.17	34.40	0.346	1.007	59.47	39.50	3.143	7.958	60.93	44.10	0.361	0.818
71.43	32.97	2.631	7.981	70.70	35.53	0.551	1.550	70.13	39.57	2.403	6.073
81.97	30.07	3.535	11.756	79.40	33.00	1.664	5.043	80.83	35.80	0.781	2.182
91.33	26.07	0.793	3.019	91.80	29.43	1.258	4.275	90.75	31.08	1.468	4.725
98.97	24.60	1.587	6.453	99.73	27.80	0.781	2.809	101.30	27.00	1.587	5.879

NOISE LEVEL MEASUREMENT

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.9			60	97.7			60	96.6		
70	99.1			70	100.0			70	98.8		
80	100.3			80	101.3			80	100.5		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.335\ V + 56.989$	-0.977
C	$SN = -0.325\ V + 59.238$	-0.977
P	$SN = -0.403\ V + 67.948$	-0.993

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 13 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Open Graded

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	67	Trap-rock	
1. F. AGG	33	Trap-rock Screenings	
2. F. AGG.	-		
MIN FILLER	-		
% ASP	5.9		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	--	6.48
MARSHALL FLOW	--	3.24
V.M.A. % VOL.	--	20.6
VOIDS % VOL.	--	4.7

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:-

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.07111		7.379	1.4564		17.864	2.7227		1.498
BWP	0.06363		3.904	1.3800		13.285	3.0210		2.668
LN C									
WP	0.07110		5.796	1.6661		9.399	2.9114		2.945
BWP	0.06275		2.811	1.4359		6.232	2.8915		3.912
LN P									
WP	0.06353		2.830	1.1061		8.046	2.4695		5.691
BWP	0.06759		6.560	1.2325		1.882	2.7053		5.292

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

SKID MEASUREMENTS DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.63	40.13	0.929	2.315	30.00	42.34	1.997	4.717	32.84	45.46	1.593	3.504
39.87	37.47	1.159	3.093	39.07	39.60	5.742	14.500	40.68	43.53	0.714	1.639
48.73	35.23	0.416	1.182	49.23	38.20	1.136	2.973	51.13	42.77	0.153	0.357
61.27	30.37	1.266	4.170	59.77	34.57	1.358	3.928	60.33	42.20	0.656	1.554
70.73	29.93	0.709	2.370	70.73	32.80	0.781	2.381	71.17	38.90	2.193	5.638
82.55	28.70	0.548	1.908	79.37	30.33	1.274	4.200	81.27	35.97	0.850	2.365
92.40	28.43	1.301	4.577	90.67	28.90	1.229	4.252	91.00	33.70	0.535	1.589
99.65	28.50	1.273	4.466	99.60	29.03	0.569	1.959	101.47	32.60	1.015	3.113

NOISE LEVEL MEASUREMENT DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.2			60	98.6			60	98.0		
70	100.5			70	100.7			70	100.1		
80	102.1			80	102.4			80	101.9		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	SN = -0.178 V + 43.882	-0.928
C	SN = -0.207 V + 47.937	-0.922
P	SN = -0.194 V + 52.179	-0.970

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 14 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Open Graded

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	67	Trap-rock	
1. F. AGG	31	Trap-rock Screening	
2. F. AGG.	--		
MIN FILLER	2	Short Fibre Asbestos	
% ASP	5.8		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	--	7.52
MARSHALL FLOW	--	3.04
V.M.A. % VOL.	--	19.6
VOIDS % VOL.	--	4.0

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES

DATE:-

	$\bar{x}$ QO	σ QO	CV QO	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN	D								
WP	0.07257		4.095	1.5031		3.888	2.7215		1.218
BWP	0.05665		8.466	1.3452		8.964	2.7443		6.719
LN	C								
WP	0.06627		4.202	1.3875		3.658	2.5723		2.208
BWP	0.05860		7.270	1.3149		12.767	2.7380		3.069
LN	P								
WP	0.06064		9.455	1.0087		8.619	2.2246		2.257
BWP	0.06160		4.289	1.1858		7.242	2.4458		2.398

PAVEMENT CLASSIFICATION

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SKID MEASUREMENTS

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.57	39.83	0.208	0.523	29.20	42.56	1.230	2.890	30.65	45.88	0.538	1.172
39.40	37.90	1.082	2.854	38.80	38.00	0.173	0.456	40.88	43.05	1.168	2.712
49.50	34.73	1.050	3.024	51.07	37.67	0.874	2.320	50.17	41.57	0.252	0.605
60.30	31.10	0.265	0.851	60.23	35.60	1.552	4.361	61.73	40.30	0.173	0.430
71.47	31.70	1.852	5.842	70.63	32.97	0.709	2.152	70.63	37.46	0.737	1.967
81.28	29.08	0.907	3.119	80.00	31.67	0.839	2.648	82.37	35.63	0.757	2.125
91.67	28.87	0.902	3.124	91.30	30.00	1.323	4.410	91.60	32.93	0.411	1.249
100.77	28.83	0.839	2.909	99.43	28.83	0.808	2.803	101.67	31.20	0.794	2.544

NOISE LEVEL MEASUREMENT

DATE

LINE-D C P

$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	97.4			60	98.7			60	98.2		
70	99.8			70	100.8			70	100.4		
80	101.2			80	102.5			80	102.1		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.162\ V + 43.293$	-0.927
C	$SN = -0.190\ V + 47.085$	-0.969
P	$SN = -0.203\ V + 51.922$	-0.990

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 15 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Open Graded

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	30	Trap-rock	
1. F. AGG	70	Trap-rock Screening	
2. F. AGG.	--		
MIN FILLER	--		
% ASP	5.6		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	--	11.91
MARSHALL FLOW	--	4.90
V.M.A. % VOL.	--	16.3
VOIDS % VOL.	--	0.7

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.08320		16.448	1.7703		10.798	3.1620		4.758
BWP	0.06685		6.762	1.6396		13.998	3.2463		4.287
LN C									
WP	0.07079		2.138	1.5101		5.777	2.7483		2.835
BWP	0.06644		4.046	1.5654		17.095	2.9559		5.913
LN P									
WP	0.06445		3.723	0.9536		6.357	2.3359		2.135
BWP	0.06650		3.645	1.1695		5.845	2.7554		3.273

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
29.95	42.67	1.124	2.634	29.54	46.54	1.534	3.296	30.73	52.03	1.360	2.614
38.93	40.33	1.193	2.958	39.77	40.40	0.458	1.134	40.06	47.48	2.137	4.501
50.70	35.63	0.404	1.134	51.90	39.00	1.114	2.855	50.00	46.33	1.286	2.775
60.37	30.90	1.054	3.410	60.30	35.07	2.122	6.052	60.83	43.17	0.902	2.089
69.87	29.77	0.451	1.515	70.53	32.40	0.458	1.414	70.37	40.77	2.376	5.827
81.68	27.05	0.881	3.258	80.57	30.30	2.211	7.298	82.97	34.60	1.513	4.374
92.40	23.87	1.429	5.989	92.37	27.37	1.286	4.698	92.13	32.68	1.135	3.475
101.33	23.60	1.153	4.887	99.90	24.67	0.808	3.277	101.93	27.73	1.250	4.508

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	96.7			60	97.5			60	97.3		
70	98.9			70	99.7			70	99.4		
80	100.4			80	101.5			80	101.0		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.278\ V + 49.983$	-0.976
C	$SN = -0.297\ V + 54.043$	-0.979
P	$SN = -0.320\ V + 61.651$	-0.978

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 16 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Open Graded

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	30	Trap-rock	
1. F. AGG	68	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	2	Short Fibre Asbestos	
% ASP	6.6		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	--	9.41
MARSHALL FLOW	--	7.79
V.M.A. % VOL.	--	18.6
VOIDS % VOL.	--	0.2

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:

	$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D									
WP	0.06899		3.067	1.1309		27.165	2.6342		9.823
BWP	0.06561		8.358	1.3374		21.539	2.9796		15.262
LN C									
WP	0.06163		2.048	1.1057		13.886	2.4687		2.486
BWP	0.06096		5.739	1.1767		1.749	2.6367		3.985
LN P									
WP	0.05760		4.230	0.8104		11.212	2.2001		5.087
BWP	0.06452		6.614	1.1302		9.827	2.6477		5.633

PAVEMENT CLASSIFICATION

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PAVEMENT SURFACE TEXTURE CLASSIFICATION

SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.03	42.23	0.306	0.723	29.44	46.36	1.419	3.060	31.43	54.70	0.781	1.428
40.70	39.67	0.321	0.810	40.23	40.27	0.451	1.120	40.04	50.00	1.530	3.059
50.07	36.73	2.146	5.841	51.37	39.93	1.756	4.397	51.77	48.20	1.058	2.196
59.87	31.03	0.802	2.585	60.87	36.37	1.701	4.677	60.83	44.30	0.608	1.373
69.63	29.87	1.501	5.026	71.30	33.40	0.899	2.661	70.73	41.50	2.910	7.013
81.95	27.28	0.574	2.104	80.70	30.47	1.266	4.156	82.83	37.10	2.088	5.628
92.37	25.03	0.833	3.326	92.60	28.17	1.097	3.895	92.33	32.53	0.714	2.194
101.50	25.43	0.586	2.304	100.37	26.90	1.082	4.021	102.33	29.07	0.839	2.885

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.0			60	98.3			60	97.3		
70	100.3			70	100.9			70	99.7		
80	101.8			80	102.8			80	101.2		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.255\ V + 48.916$	-0.963
C	$SN = -0.273\ V + 53.302$	-0.979
P	$SN = -0.348\ V + 65.187$	-0.985

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401 DATE CONSTRUCTED 1974

TEST SECT 17 LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE Mastic

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	70	Trap-rock	
1. F. AGG	19	Trap-rock Screenings	
2. F. AGG.	--		
MIN FILLER	9 2	Mineral Filler Short Fibre Asbestos	
% ASP	7.5		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	--	8.39
MARSHALL FLOW	--	14.48
V.M.A. % VOL.	--	21.0
VOIDS % VOL.	--	1.0

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES DATE:-

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D								
WP 0.06528		9.124	1.5288		13.148	2.6013		2.653
BWP 0.06057		3.972	1.3815		9.236	2.7426		5.830
LN C								
WP 0.06731		1.948	1.5363		9.976	2.6325		4.160
BWP 0.06200		5.456	1.1982		6.939	2.5100		6.087
LN P								
WP 0.06246		7.829	1.2297		9.706	2.4889		4.503
BWP 0.06909		3.904	1.2671		21.573	2.5539		13.726

PAVEMENT CLASSIFICATION

Class
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PAVEMENT SURFACE TEXTURE CLASSIFICATION

PAGE 2

SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
31.60	38.57	0.493	1.279	30.06	41.10	1.428	3.475	32.20	42.43	1.014	2.391
41.50	35.60	1.513	4.251	41.10	35.26	0.723	2.051	41.62	39.44	1.406	2.566
50.87	32.37	1.185	3.660	52.27	34.33	0.902	2.627	53.93	35.93	0.751	2.089
61.30	28.20	1.136	4.028	60.53	32.33	2.003	6.196	61.43	36.20	0.954	2.635
70.60	28.10	0.361	1.283	69.37	30.83	0.306	0.991	69.43	33.03	0.896	2.713
80.23	25.43	1.079	4.241	80.07	27.37	0.907	3.316	80.43	29.57	1.185	4.007
91.37	24.67	1.767	7.165	91.47	25.47	1.955	7.678	90.10	26.78	1.580	5.900
99.20	25.47	0.751	2.947	99.13	24.83	1.350	5.437	100.67	23.40	1.706	7.290

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.9			60	99.7			60	98.9		
70	101.4			70	101.4			70	101.3		
80	103.5			80	103.8			80	102.9		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	$SN = -0.205\ V + 43.287$	-0.933
C	$SN = -0.232\ V + 46.751$	-0.956
P	$SN = -0.269\ V + 51.132$	-0.981

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

PAVEMENT SURFACE TEXTURE CLASSIFICATION

HWY. 401　　DATE CONSTRUCTED 1974

TEST SECT 19　　LOCATION Toronto by-pass

TEST SECT DESCRIPTION

MIX TYPE HL1

MIX COMPOSITION

	%	TYPE	SOURCE
C. AGG.	45	Trap-rock	
1. F. AGG	41	Natural Sand	
2. F. AGG.	14	Limestone	
MIN FILLER	--		
% ASP	5.4		

MIX CHARACTERISTICS

	LAB	FIELD
MARSHALL STABILITY	7.22	12.56
MARSHALL FLOW	2.63	3.70
V.M.A. % VOL.	16.9	14.6
VOIDS % VOL.	2.8	0.4

C. AGG. PROPERTIES

PSV = 45
AAV = 2.2
LA. = 13.4
PN. =

PAVEMENT REFLECTANCE PROPERTIES　　DATE:-

$\bar{x}$ Q0	σ Q0	CV Q0	$\bar{x}$ S1	σ S1	CV S1	$\bar{x}$ S2	σ S2	CV S2
LN D								
WP 0.09432		2.189	2.2317		7.667	3.4922		6.293
BWP 0.06908		5.998	1.4691		3.132	2.7533		1.538
LN C								
WP 0.08466		7.296	1.7829		18.972	2.9516		12.718
BWP 0.06567		12.271	1.5863		7.981	2.929		7.716
LN P								
WP 0.06949		9.324	1.1251		12.276	2.3837		4.488
BWP 0.07915		14.372	1.5107		21.506	2.9558		12.358

PAVEMENT CLASSIFICATION

Class
Erbay Atlas Table No

PAVEMENT SURFACE TEXTURE CLASSIFICATION

SKID MEASUREMENTS

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	C.V. SN	$\bar{x}$ SPEED	$\bar{x}$ SN	σ SN	CV SN
30.97	37.73	0.723	1.917	30.20	39.22	1.158	2.594	31.68	41.75	1.948	4.752
40.47	33.80	0.794	2.348	41.43	32.47	1.124	3.461	41.60	39.88	1.599	4.010
49.73	29.90	0.889	2.973	50.53	31.67	1.401	4.425	52.50	35.90	1.277	3.556
60.13	25.33	0.351	1.386	59.87	29.80	2.364	7.934	61.03	34.03	1.193	3.505
72.00	22.83	1.504	6.589	69.07	26.40	0.608	2.304	68.80	32.47	0.651	2.004
82.00	19.87	1.012	5.092	79.83	24.63	0.379	1.537	80.57	29.17	2.113	7.243
92.27	17.33	0.666	3.841	91.73	21.30	0.361	1.693	90.28	24.95	0.443	1.777
99.70	17.73	0.451	2.543	100.27	19.03	0.404	2.123	101.50	23.80	1.908	8.016

NOISE LEVEL MEASUREMENT

DATE

LINE-D				C				P			
$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	C.V. dB	$\bar{x}$ SPEED	$\bar{x}$ dB	σ dB	CV dB
60	98.5			60	99.4			60	98.2		
70	100.6			70	101.6			70	100.9		
80	102.0			80	103.3			80	102.5		

SKID NUMBER vs VEHICLE SPEED

LN	Equation	R
D	SN = -0.301 V + 45.403	-0.977
C	SN = -0.272 V + 45.987	-0.976
P	SN = -0.272 V + 50.698	-0.974

LEGEND

Asp	Asphalt
AAV	Aggregate Abrasion Value
BWP	Between Wheel Path
C. Agg.	Coarse Aggregate
Eq.	Equation
F. Agg.	Fine Aggregate
LN.	Lane
LAB.	Laboratory Measurement
Min	Mineral
PSV	Polish Stone Value
PN	Petrographic Analysis
SECT	Section
V.M.A.	Voids Mineral Aggregate
Vol	Volume
WP	Wheel Path
r	Co-efficient of Correlation
L.A.	Los Angeles abrasion
D.	Driving Lane
C.	Center Lane
P	Passing Lane

POOR

QUALITY

ORIGINAL